Bayou Grosse Tete

Watershed Implementation Plan

Louisiana Department of Environmental Quality, NPS Unit

DEQ
LOUISIANA

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1.0 INTRODUCTION

According to the United States Environmental Protection Agency, nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many different sources, such as rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. These pollutants can include: excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas; oil, grease, and toxic chemicals from urban runoff and energy production; sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks; salt from irrigation practices and acid drainage from abandoned mines; bacteria and nutrients from livestock, pet wastes, and faulty septic systems; and atmospheric deposition and hydromodification; The effects of nonpoint source pollutants on specific waters vary and may not always be detrimental. However, states report that nonpoint source pollution is the leading remaining cause of water quality problems fully assessed. In addition, it is known that these pollutants have harmful effects on drinking water supplies, recreation, fisheries, and wildlife.

The Louisiana Department of Environmental Quality (LDEQ) has identified Bayou Grosse Tete as a waterbody that does not meet all of the water quality standards; consequently, it was placed on the State of Louisiana's 303(d) List of Impaired Waters in 2002 and 2004. According to the LDEQ assessment the suspected cause of impairment to the waterbody is organic enrichment/low DO from onsite treatment systems and from irrigated and non-irrigated crop production. Subsequently, an intensive survey of the Bayou was conducted, and in October 2006, a Total Maximum Daily Load Report (TMDL) was prepared for the Bayou Grosse Tete Watershed, including Bayou Portage(formerly Subsegment 120101) and Bayou Fordoche(formerly Subsegment 120112), by the Louisiana Department of Environmental Quality (LDEQ), and was finalized and approved by EPA in July 2007. The TMDL summarized the maximum amount of a pollutant that Bayou Grosse Tete can assimilate and still meet water quality standards for its designated uses, in addition to giving the goals for the reduction of those pollutants. Summer and winter projections of Bayou Grosse Tete were modeled to quantify the point source and nonpoint source waste load reductions necessary so that the bayou would comply with its established water quality standards and criteria.

Section 319 of the Clean Water Act (PL 100-4, February 4, 1987) was enacted to specifically address problems attributed to nonpoint sources of pollution. Its objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters (Sec. 101; PL 100-4).

The Louisiana Department of Environmental Quality is presently the designated lead agency to implement the Louisiana State Nonpoint Source Program. The LDEQ Nonpoint Source Unit and the Louisiana Department of Agriculture and Forestry (LDAF) provide §319(h) funds to assist in the implementation of BMPs to address water quality problems on subsegments listed on the §303(d) list. USEPA §319(h) funds are utilized to sponsor cost sharing, monitoring, and education projects. These monies are available to all private, profit and

Figure 1 Drain emptying into Bayou Grosse Tete

nonprofit organizations that are authentic legal entities, or governmental jurisdictions.

This watershed plan lays out a course of action that can be implemented with the prospect that nonpoint source (NPS) pollution in the watershed may be reduced such that the streams and rivers meet the water quality standards. This plan will be the basis for outlining how and where the State and the local cooperators should focus their efforts and future resources within the watershed in order to re-attain its designated uses and improve water quality. In trying to improve and protect water quality, all residents and all interested government parties should partake in public education, in hopes that they will support the efforts to implement the best management practices (BMPs).In agricultural watersheds, such as Bayou Grosse Tete, the implementation of conservation tillage, riparian zones, and residue management programs are some of the recommended courses of action for reducing pollutant runoff from sugar cane, cotton, wheat, and pasture. Directing new development away from streams and rivers, inspecting 100% of newly installed septic systems and refraining from using septic system additives were among the many BMPs recommend for Urban/Residential Developments. Hydromodification and forestry were also shown to contribute to low DO conditions and thus best management practices for these nonpoint source pollutant sources will be presented in this plan as well. When incremental Section 319 funds are utilized for BMP implementation, they should be applied in targeted areas and tracked by LDEQ, LDAF and USDA to see if load reductions are occurring and water quality is improving as a result of expenditure of federal funds. A consolidated list of recommended BMPs for crop agriculture and other land uses can be found in the State of Louisiana Water Quality Management Plan, volume6, http://nonpoint.deq.louisiana.gov/wqa/default.htm.

1.1 Elements of the Watershed Protection Plan

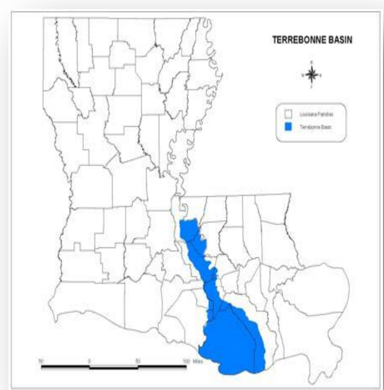


Figure 2 Map of the Terrebonne Basin

In promoting watershed based planning, the EPA has outlined nine elements necessary to a successful establishment of a watershed protection plan. The following steps provide a template for creation, implementation, and review of watershed protection efforts. While the composition and strategy of watershed protection plans vary, the basic elements should include the following:

1. Identify sources and causes of pollution
2. Estimate necessary load reductions
3. Describe point and nonpoint source management measures
4. Assess the technical and financial assistance needed
5. Design an informational/educational component
6. Develop a schedule of implementation
7. Set interim measurable milestones for progress
8. Establish criteria to determine load reductions
9. Create a monitoring component

The following plan touches on the nine elements although not necessarily in the order presented by the Environmental Protection Agency.

2.0 BAYOU GROSSE TETE LAND USE

Bayou Grosse Tete is the second largest unit of the selected subsegments in the Terrebonne Basin with 68,341 acres. The Terrebonne Basin covers approximately 1,712,500 acres in south-central Louisiana, and varies in width from 18 miles to 70 miles. The topography of the entire basin is lowland, and all the land is subject to flooding except the natural levees along major waterways (LDEQ, 1994). Approximately 729,000 acres of the Terrebonne Basin are wetlands which consist of about 21% freshwater swamp and 79% marsh. The two primary water sources that enter this system are rain water and flood water from the Atchafalaya River, which contain nutrient-rich sediments that overwhelm the southwestern coastal marshes. Bayou Grosse Tete is dominated by Forest and Agricultural Lands; combined, they occupy over 90% of the subsegment. The majority of the land use along the bayou is agriculture, such as sugar cane, soybeans, pasture/hay/idle, and urban areas, occupying less than 5%.

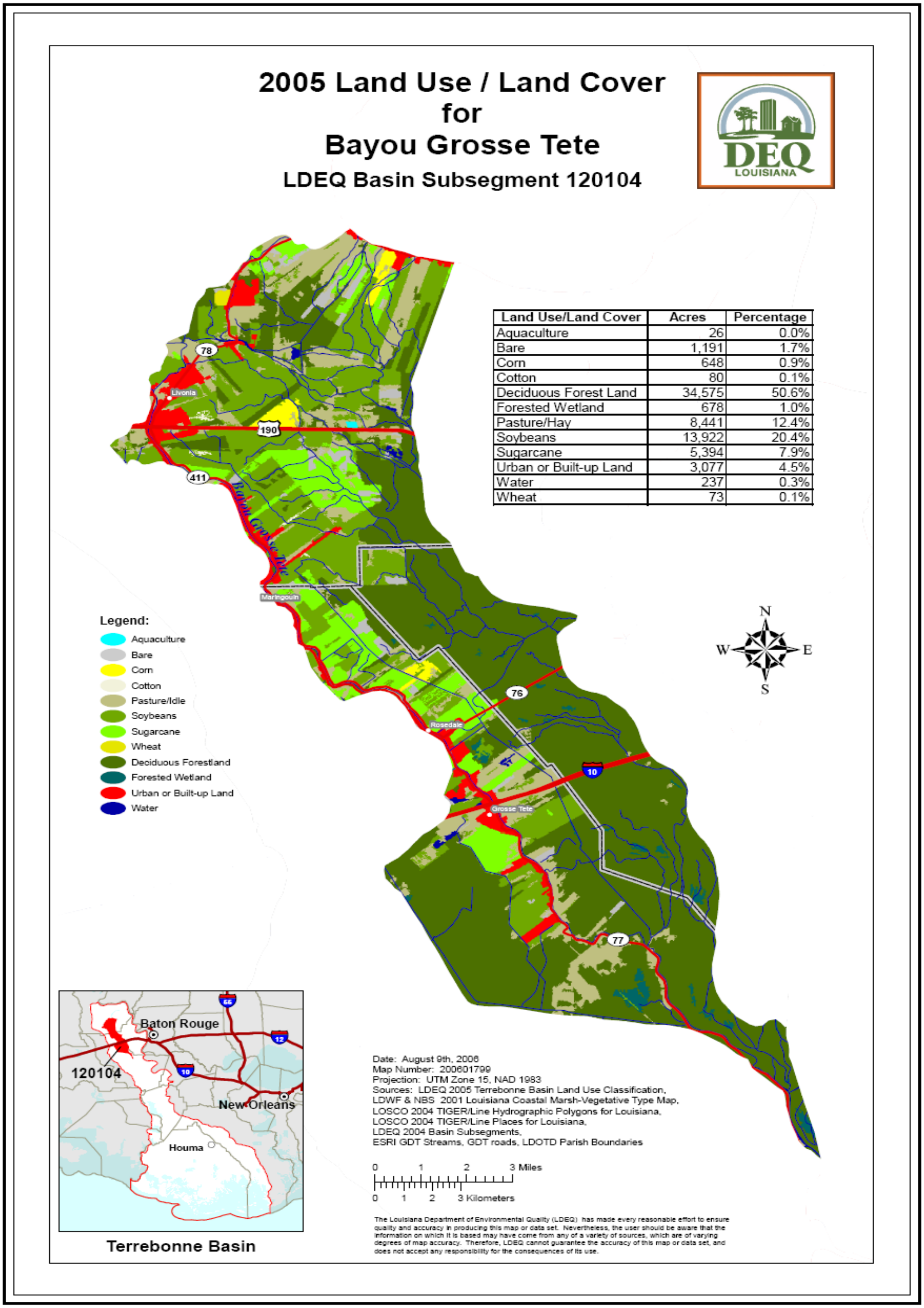
Figure 3 LDEQ Field Survey sampling site


Figure 6 Deer hunting camp near the banks of Bayou Grosse Tete


Figure 4 Bayou Grosse Tete sampling site of LDEQ Field Survey Team; showing dirt on bank of bayou and film on surface of water


Figure 7 Cement lined ditch emptying into Bayou Grosse Tete


Figure 5 Ferry used for hunting and fishing equipment, and ATV's



Land Use/Land Cover	Acres	Percentage
Aquaculture	26	0.0%
Bare	1,191	1.7%
Corn	648	0.9%
Cotton	80	0.1%
Deciduous Forest Land	34,575	50.6%
Forested Wetland	678	1.0%
Pasture/Hay	8,441	12.4%
Soybeans	13,922	20.4%
Sugarcane	5,394	7.9%
Urban or Built-up Land	3,077	4.5%
Water	237	0.3%
Wheat	73	0.1%

Figure 8 Bayou Grosse Tete, 2005 Land Use Cover Map

2.1 Bayou Grosse Tete Watershed Description

Bayou Grosse Tete is approximately 28 miles long. It is in the northern part of the Terrebonne Basin. The bayou originates at the False River Overflow Canal and flows westward for about 5 kilometers, where it then flows together with Bayou Portage. Bayou Grosse Tete then turns southwest for 3 kilometers to the mouth of Bayou Fordoche, and from here, Bayou Grosse Tete continues in a southeast direction for approximately 45 kilometers before flowing into the Intracoastal Waterway. The subsegment has a drainage area of 620.74 square kilometers (239.7 square miles). It is bounded on the north by the Mississippi River and False River; on the east by Bayou Cholpe and Bayou Choctaw drainage areas; on the west by the East Atchafalaya Basin Protection Levee and the Bayou Maringouin drainage area; and on the south by the Intracoastal Waterway and the Upper Grand River drainage area. A section of the headwaters travels eastward and crosses the Tolbert weir. This current continues across the subsegment's boundary, joins with Bayou Cholpe, but never rejoins the Bayou Grosse Tete system. A site visit of the Bayou Grosse Tete watershed was conducted on April 3, 2008, and a follow-up visit was carried out on June 11, 2008. Details of the visits are noted throughout the plan.

Figure 9 Forestry activities in the Village of Grosse Tete

Figure 12 Livonia Weir that crosses Bayou Grosse Tete

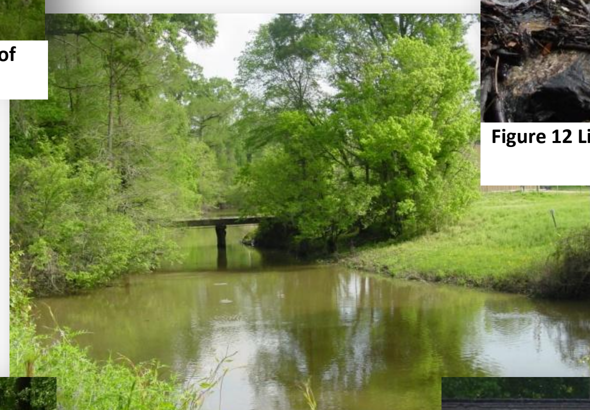


Figure 11 Foot bridge crossing Bayou Grosse Tete

Figure 10 Stretch of Bayou Grosse Tete

Figure 13 The Village of Grosse Tete

3.0 WATER QUALITY ANALYSIS

Summer and winter projections of Bayou Grosse Tete were modeled to quantify the point source and nonpoint source waste load reductions necessary in order for the bayou to comply with its established water quality standards and criteria. The designated uses and the water quality standards for Bayou Grosse Tete are shown in Table 2: Water Quality Criteria and Designated Uses for Bayou Grosse Tete, page 12. The primary standard for the TMDLs was the DO standard of 5 mg/L all year round.

3.1 Water Quality Assessment

Bayou Grosse Tete, subsegment 120104, appeared on the 2002 and 2004 303(d) lists, and was found to not be supporting its designated uses of primary contact recreation and fish and wildlife propagation. The bayou was, however, found to be fully supporting its designated use of secondary contact recreation. In no particular order, the impairment is thought to be caused by pesticides (atrazine), oxygen depletion (dissolved oxygen (DO)), nutrients (nitrite/nitrate, phosphorous), pathogens (total and fecal coliform), sedimentation/siltation, total suspended solids, and salinity/TDS/chlorides (total dissolved solids). According to the 2004 and 2006 Integrated Reports, new data shows attainment in Bayou Grosse Tete for total suspended solids, sedimentation/siltation, and also for oil and grease.

3.1.1 Stream Survey Data

Bayou Grosse Tete was targeted for a survey with the intention of populating a TMDL Model for oxygen demand substances and pollutants. The watershed survey was performed by the Watershed Survey Section, and lasted for three days (09/24/2001- 09/26/2001). The team surveyed the stream during summer, critical conditions, with the aim of retrieving data to satisfy the scope of the TMDL project. A map of the survey sites is shown on page 10, Figure's 17 and 18, along with a legend of the names/description of each site, page 11, Table 1.

The continuous monitors were put out on the first day and picked up on the last. On the actual sampling day (09/25/2001), the bayou had positive flow in some areas, but by afternoon, the flow was positive and negative at times. According to the survey, the bayou appeared "to be sloshing back and forth, possibly due to the navigational locks downstream, and barge traffic moving along the Intracoastal Waterway"(LDEQ. 2001). Representative cross-sections were taken at sites that were specified by the survey, and also at sites where estimated float measurements were taken. Where vertical axis current meters could be used, actual flows were taken at main stem and tributary sites. Some of the flow measurements were cancelled because of change in flow directions during the afternoon; however, the data was reported for reference. Water samples were collected at all tributary and main stem sites, even though water levels were falling throughout the survey. Eight continuous monitors were set out and no problems with the monitors or data were reported.

Figure 15 Bayou Grosse Tete

Figure 14 Bayou Grosse Tete

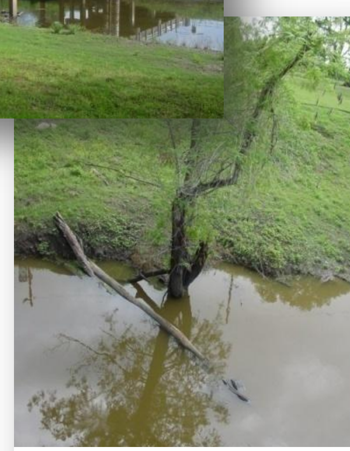


Figure 16 Bayou Grosse Tete

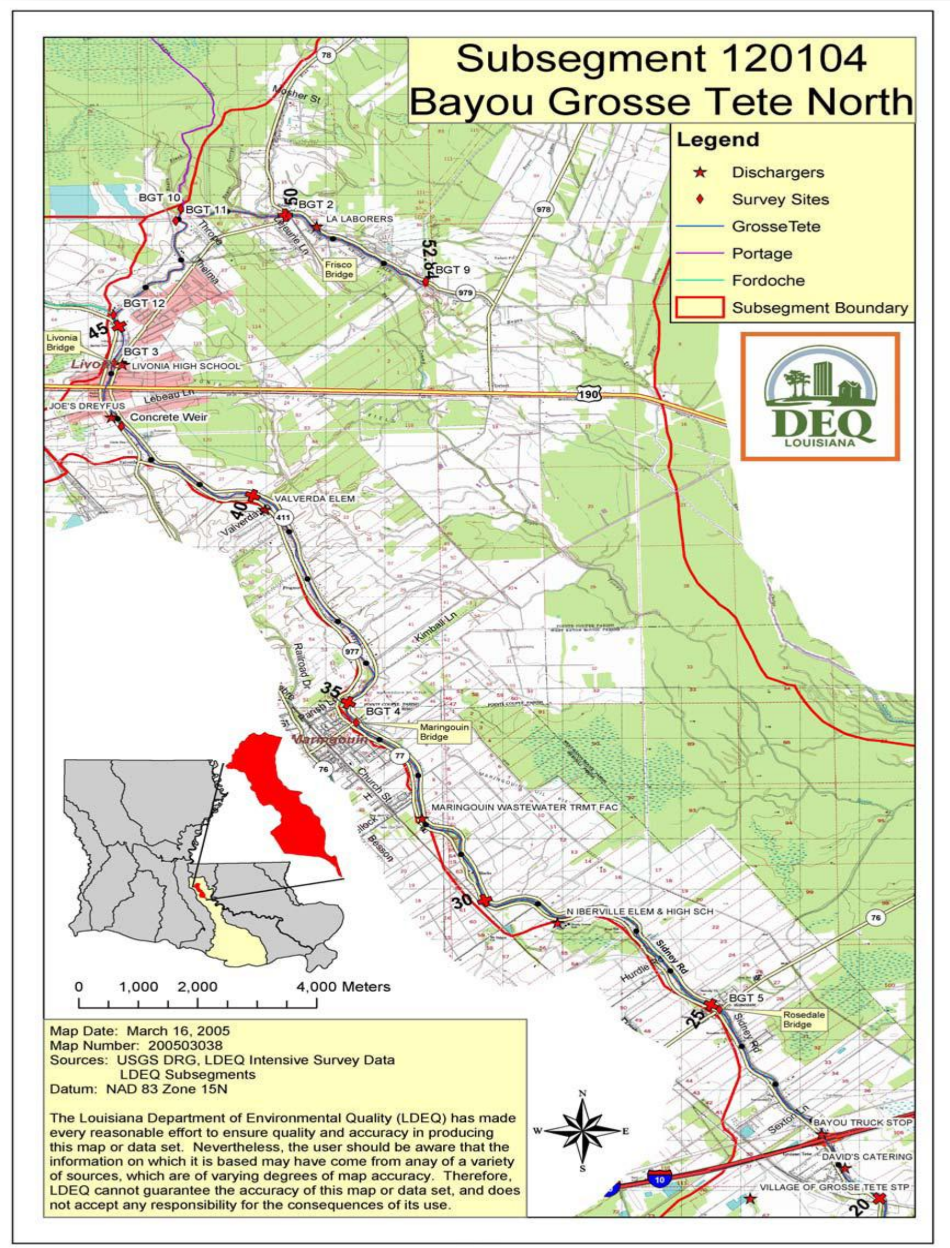


Figure 17 Map of Northern Bayou Grosse Tete Study Area

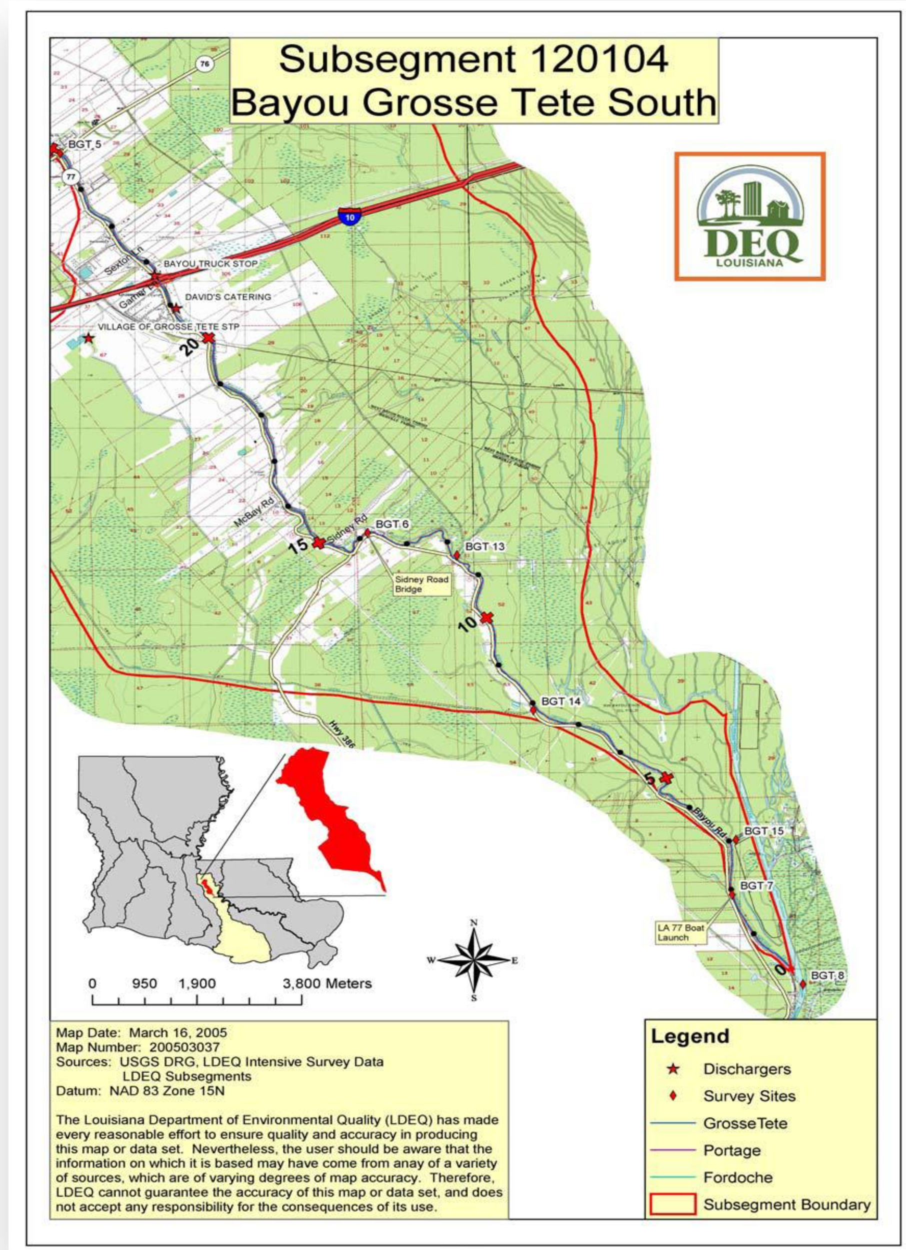


Figure 18 Map of Southern Bayou Grosse Tete Study Area

Site	Description/Name of Site	DO	Observations
BGT 1a	Bayou Grosse Tete: upstream of rock weir; on unnamed road about 2 miles east of corner of LA Hwys 978 & 979	DO: 3.26 DO%: 37.4	Flowing upstream; water greenish—tan color to a tea color; elevation of water above and below dam; drogues placed upstream of weir—no movement
BGT 1b	Bayou Grosse Tete: downstream of rock weir; on unnamed road about 2 miles east of corner of LA Hwys 978 & 979	DO: 2.33 DO%: 26.6	Flowing upstream; water greenish—tan color to a tea color; elevation of water above and below dam
BGT 2	Bayou Grosse Tete: Frisco Bridge (LA Hwy 411); about 3 miles north of US Hwy 190	DO: 4.03 DO%: 47.5	Water color: greenish brown No movement noted; no flow recorded; oil and grease evident
BGT 3	Bayou Grosse Tete: Livonia Bridge(Bridge Rd.); about ¼ mile north of US Hwy 190	DO: 2.8 DO%: 32.6	Water color: brownish green; attempted flow with current meter but could not get meter to read
BGT 4	Bayou Grosse Tete: Maringouin Bridge; about 6 miles south of US Hwy 190		No flow; water is black
BGT 5	Bayou Grosse Tete: Rosedale Bridge (LA Hwy 76); about 2 miles north of I-10	DO:3.28 DO%:40.9 @1.0 M DO:1.39 DO%:16.6 @2.0M	Minimal flow; water is black/dark brown and murky; flowing downstream
BGT 6	Bayou Grosse Tete: Sidney Rose Bridge; about 5 miles south of I-10	DO: 1.52 DO%: 18.7	Minimal flow; water is black
BGT 7	Bayou Grosse Tete: downstream of LA Hwy 77 Boat Launch; about 100 yards downstream of boat launch	DO: 2.85 DO%: 34.4	
BGT 8	Intracoastal Waterway: downstream of confluence with Bayou Grosse Tete	DO:4.98 DO%:62.6 @1.0M DO:5.05 DO%:63.6 @2.0M DO:4.93 DO%:63.3 @3.0M	No canopy
BGT 9	False River Overflow Canal: LA Hwy 979 Bridge; about 2 miles east of Frisco	DO: 3.69 DO%: 43.1	Water color: greenish brown The little flow present could be completely reversed by the wind
BGT 10	Bayou Portage: upstream of confluence with Bayou Grosse Tete; about 2 miles upstream of Callicot Road boat launch		No drogue movement; no visible flow; stagnant water; water color—greenish tan; heavy canopy ~80%
BGT 11	Unnamed Canal near Bayou Portage: upstream of confluence with Bayou Grosse Tete; about 2 miles upstream of Callicot Road boat launch		Drogues placed at bridge—no movement; no visible water flow; water color--greenish
BGT 12	Bayou Fordoche: upstream of confluence with Bayou Grosse Tete; about 50 yards downstream of Callicot Road boat launch	DO: 4.84 DO%: 54.1	Water color: brownish clear; no flow
BGT 13	Grand Bayou: upstream of confluence with Bayou Grosse Tete; about 10 miles upstream of LA Hwy 77 boat launch	DO: 2.77 DO%: 31.5	
BGT 14	Catfish Canal: culvert on LA Hwy 77; about 12 miles south of I-10	DO: 4.26 DO%: 46.1	Flowing; water color is clear; stream bed approx. 3 ft. deep of sludge making cross-section hard to get; flowing into Bayou Grosse Tete; being dredged upstream of LA Hwy 77 culvert
BGT 15	Intracoastal Waterway Diversion Canal; upstream of confluence with Bayou Grosse Tete; about 1 mile upstream of LA Hwy 77 boat launch	DO: 1.5 DO%: 18.4	Water color was muddy; flow changed directions during discharge measurement

Table 1 Name and Description of Survey Sites

3.1.2 Ambient Data

Beginning in 2004 LDEQ changed from a five-year rotating monitoring cycle to a four-year cycle. This change allows for the same level of water quality monitoring over a shorter period of time. The four-year cycle also permits a more balanced schedule of water quality assessments for Integrated Reporting (305(b) and 303(d)) purposes. Approximately one quarter of the states watersheds will be sampled in each year so that all of the states watersheds will be sampled within the four year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. LDEQ maintained one sampling location (0970) on Bayou Grosse Tete as part of the Statewide Water Quality Monitoring Network. Data was collected monthly in 2000 and 2004 and again in 2007 and 2008 from this site. Data information was obtained from the Water Quality Assessment Division, Standards and Assessment Division. A comparison of the 2000, 2004, 2007, and 2008 sampling data are presented in the graphs to follow. For the months where more than one sample was taken, an average was taken for the samples. The water quality standards for Bayou Grosse Tete are listed in the table below. Water quality standards form the basis for implementing best management practices for the control of nonpoint sources of water pollution.

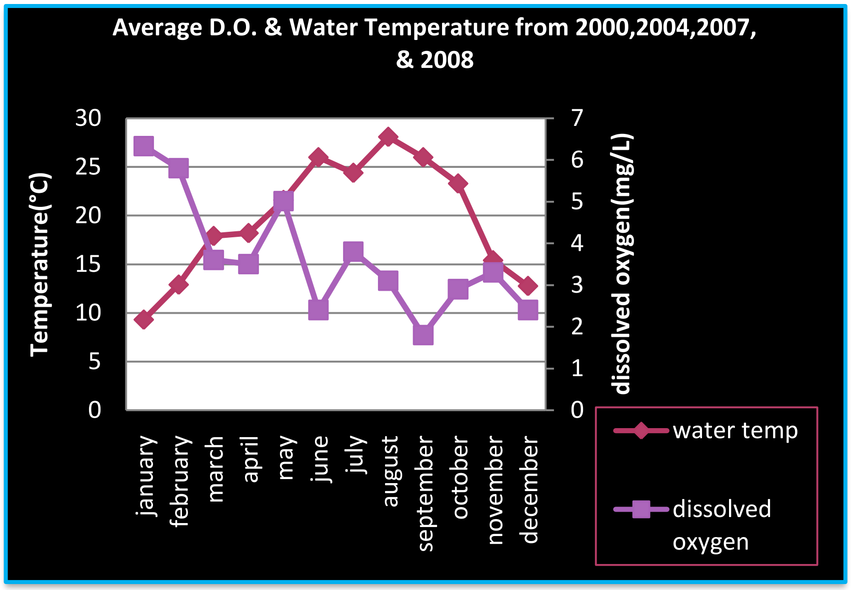
Water Quality Parameter	Numerical Criteria
Chloride (Cl)	**25**
Sulfate (SO_4)	**25**
Dissolved Oxygen (DO)	**5.0**
pH	**6.0-8.5**
Bacterial Criteria (BAC)	**See note 1**
Temperature (°C)	**32**
Total Dissolved Solids (TDS)	**200**
Designated Uses	A,B,C

Table 2 Water Quality Criteria and Designated Uses for Bayou Grosse Tete

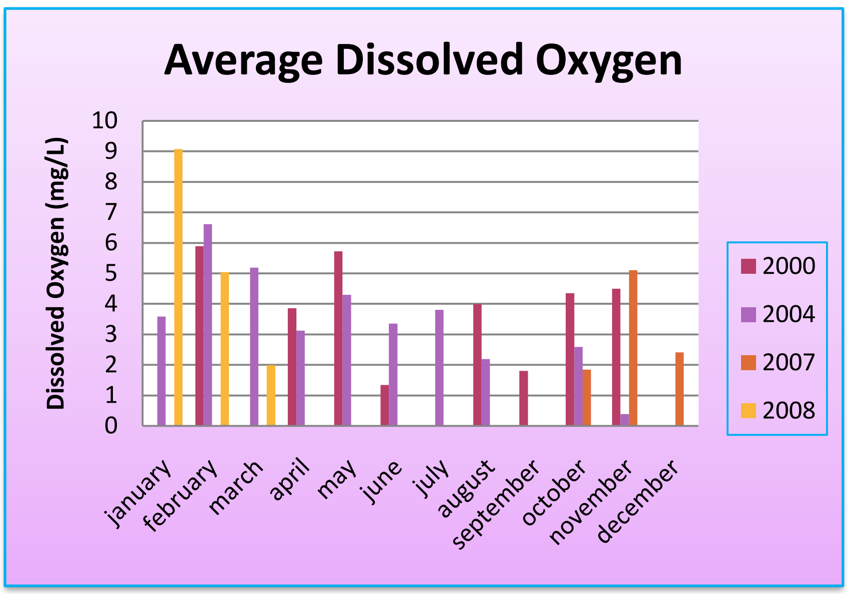
Note 1: 200 colonies/100ml maximum log mean and no more than 25% of samples exceeding 400 colonies/100ml for the period of May through October; 1,000 colonies/100ml maximum log mean and no more than 25% of samples exceeding 2,000 colonies/100ml for the period of November through April

USES: A-primary contact recreation; B-secondary contact recreation; C-propagation of fish and wildlife; D-drinking water supply; E-oyster propagation; F-agriculture; G-outstanding natural resource water; L-limited aquatic life and wildlife use

The monthly average of D.O. and water temperature data from the years 2000, 2004, 2007, and 2008 were calculated to construct the graph showing the inverse relationship of D.O. and water temperature. In Bayou Grosse Tete, this trend was followed as the D.O. increased when the water temperature decreased. The water quality standard of 5.0 mg/L of dissolved oxygen was maintained only during January, February, and May, when the temperature was mild. Dissolved Oxygen reached its lowest in June, August and September when the temperature was at its highest.

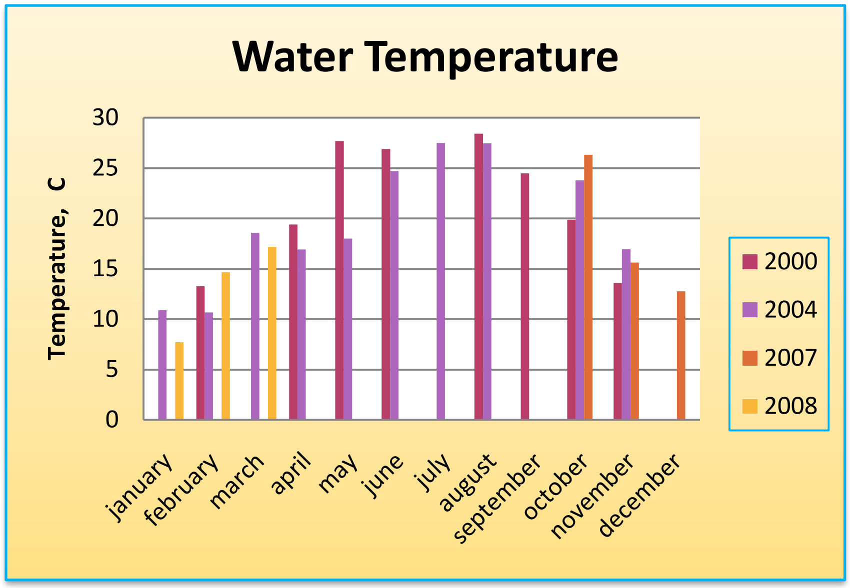


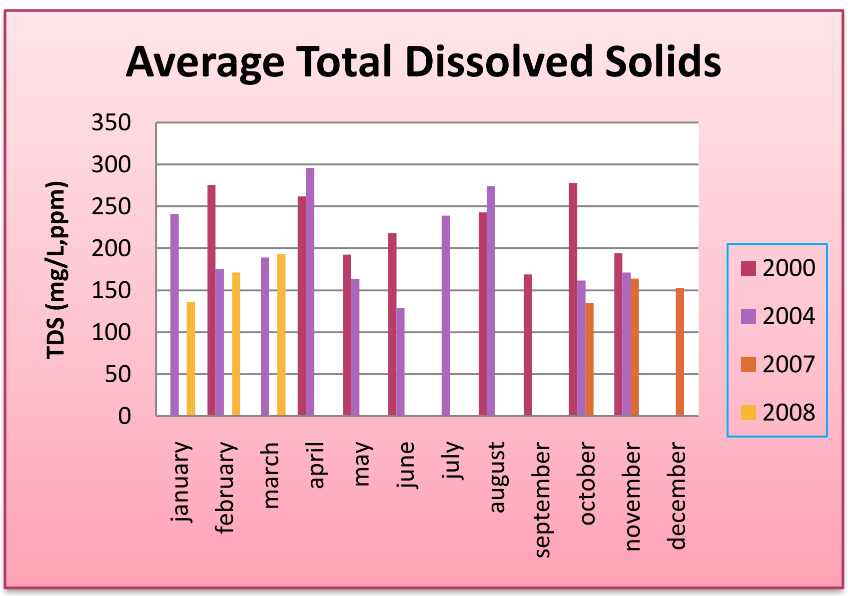
For the remaining charts, the data collected from 2000, 2004, 2007, and 2008 were plotted on the same chart to enable a comparison between the years. This technique will show improvement or deterioration of water quality between the years, and if seasonal trends are present, it will be apparent. Agricultural activities, such as fertilizing, irrigation, and tilling, also occur during certain times of the year, which can cause seasonal deterioration of the water quality.



The D.O. in Bayou Grosse Tete appears to have been higher in May 2000 than in May 2004. It is quite evident that the dissolved oxygen concentration is typically higher in the cooler months (January, March, and November) for the most part and lower in the warmer months (September, October, November). The dissolved oxygen concentration hit an all time high in January 2008, but dropped off to one of the lowest concentrations by March 2008.

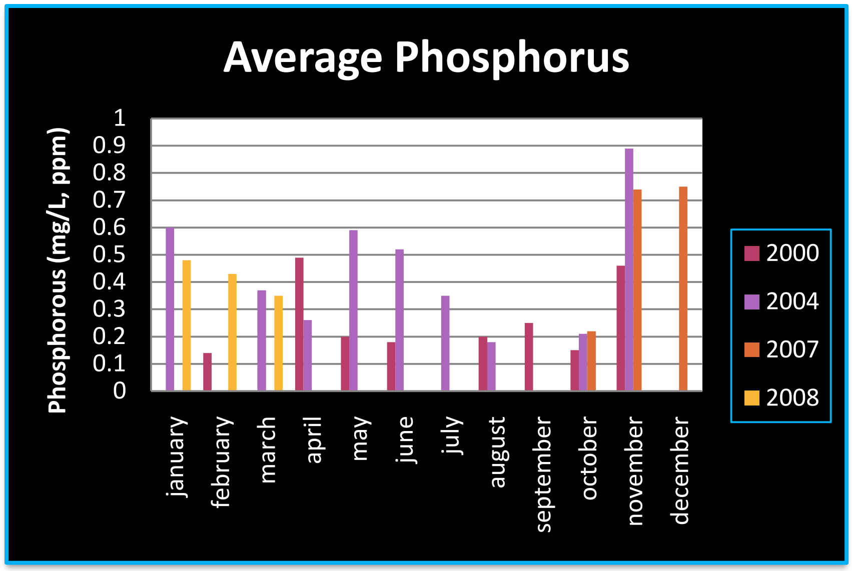
For the years 2000, 2004, 2007, and 2008, the ambient data shows that the water temperature in Bayou Grosse Tete was cooler in the winter months, and warmer in the summer months, as expected. The standard for Bayou Grosse Tete is 32 °C or below, and from 2000-2008, Bayou Grosse Tete met the criteria. According to the graph, the water temperature usually hits its peak around July and August. The temperatures seem to follow the same trend over the years; consequently, water temperature through the seasons in Bayou Grosse Tete remains fairly constant.



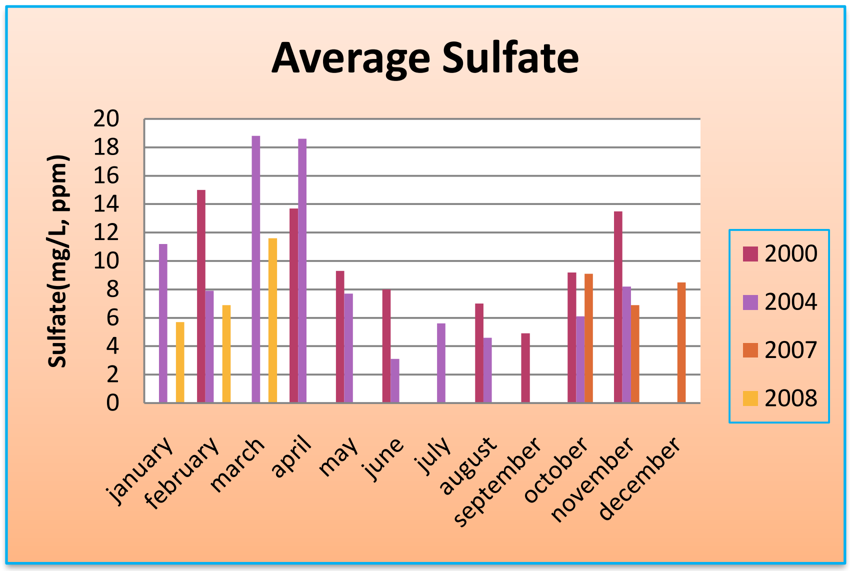


The Bayou Grosse Tete numerical criteria for Total Dissolved Solids states that TDS can not exceed 200 mg/L. As shown by the data present, the standard of 200 mg/L was only maintained in February, March, May, June, October and November in 2004; January, February, and March in 2008; and in October, November, and December in 2007. In 2000, TDS levels were at there highest almost all year round. The data from 2000-2008, appears to show that the average total dissolved solid levels have been declining.

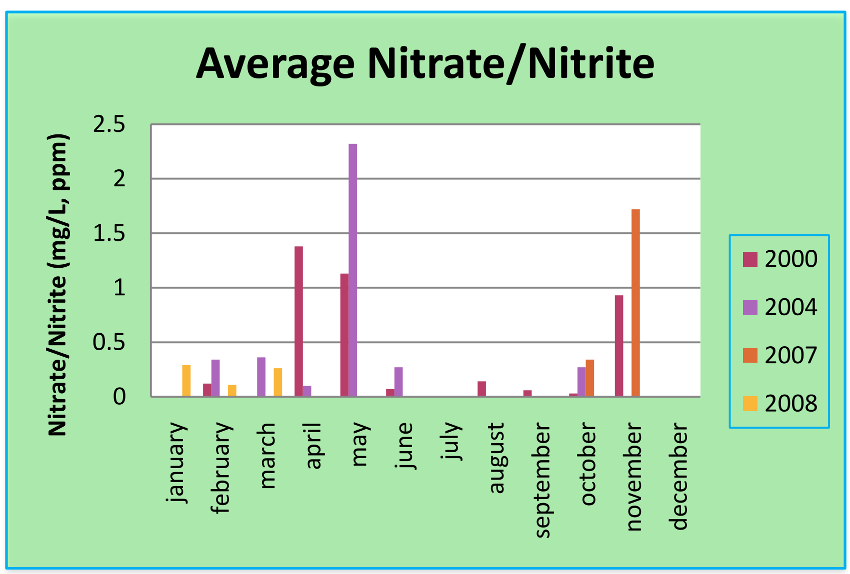
The level of Phosphorus increased sharply in the cooler months of October, November, and December in 2004 and 2007. It seems that as a seasonal trend, the concentration of phosphorus increases during that time period, as also shown in 2000. The concentration of phosphorus seems to stay low during the warmer months as shown on the graph, from about May to August. Levels of phosphorus stayed on the low range for the most part in 2000, and have been steadily increasing.

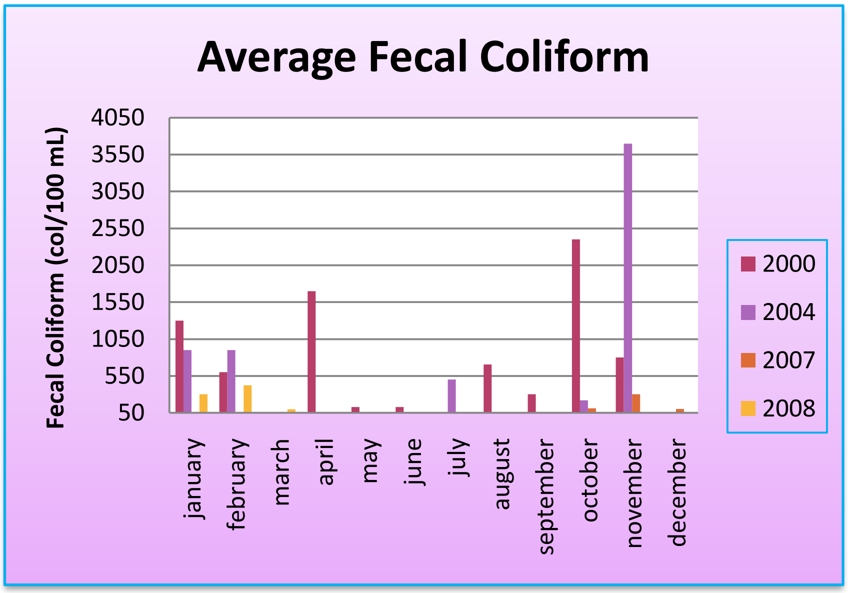


The numerical criteria for sulfate are set at 25 mg/L or below. According to the data from 2000, 2004, 2007, and 2008, Bayou Grosse Tete is meeting the standard. From all years, the data shows that there is a peak in sulfate concentrations from about February to about April. The concentrations seem to stay low from about May to September of each year.



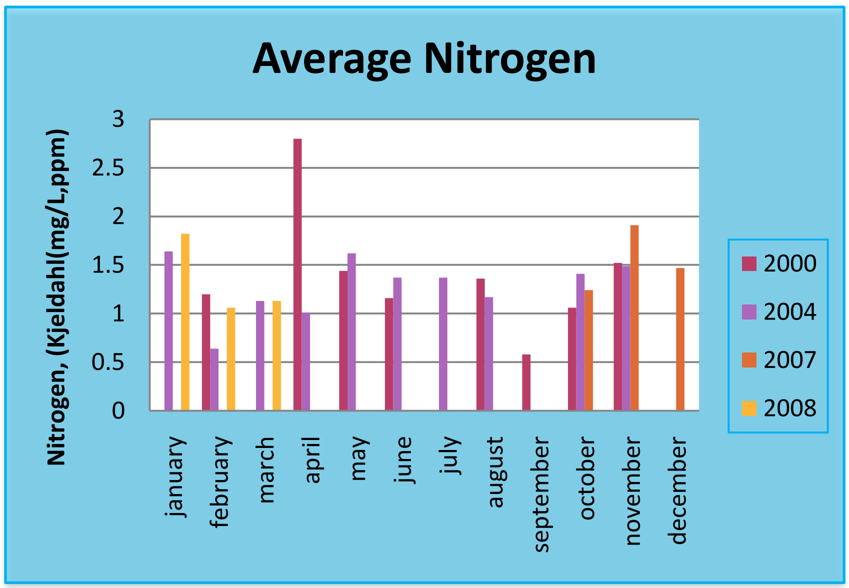
The average levels of Nitrate/Nitrite increase around May, but seem to decrease in June. There also seems to be a spike in concentration from October to November. In 2000, the overall concentration of nitrate/nitrite was low; there was a spike in concentration in 2004; from the data in 2007 (October and November) concentrations were low and spiked suddenly. In 2008, data shows concentrations were low in January, February and March; however, there is no way to know what the concentrations were in the remaining months because no data was taken. In spite of this, the trend shows that concentrations are usually low and spike suddenly.

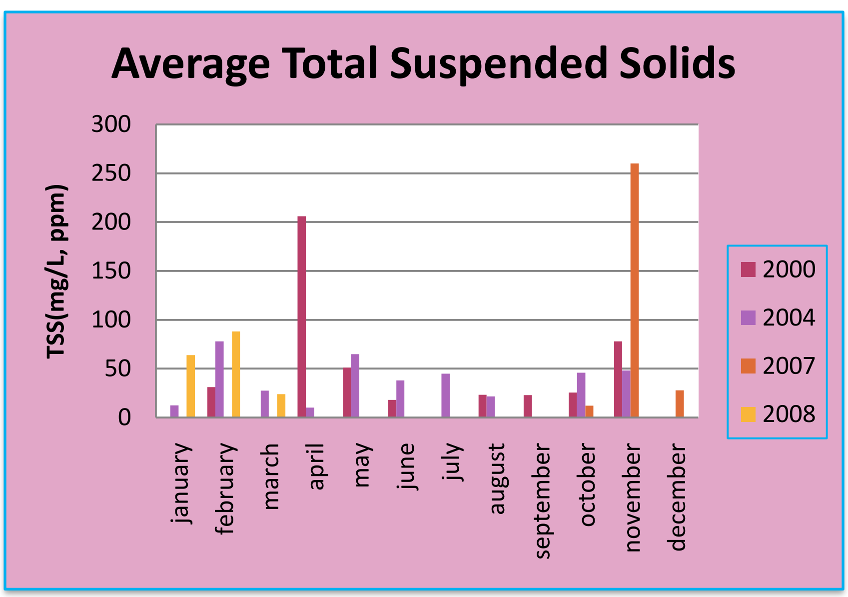




For the period of May through October for years 2000, 2004, 2007, and 2008, it appears that Bayou Grosse Tete has been adhering to the fecal coliform standard of having 200 colonies/100ml of fecal coliform samples and no more than 25% of the samples exceeding 400 colonies/100 ml. It also seems that for the standard stating that no more than 25% of the samples can exceed 2,000 colonies/100 ml for the period of November through April has been habitually exceeded. However, when looked at as a whole, it looks as if the fecal coliform concentration has been consistently decreasing since 2000.

Total Kjeldahl Nitrogen is the amount of organic nitrogen plus ammonia. It does not include inorganic nitrogen, such as nitrate, nitrite, and ammonium. The TKN levels stayed around the same concentrations for years 2000, 2004, 2007, and 2008, with the exception of a sudden spike in concentration in May of 2000.





The average total suspended solids concentrations seem to stay relatively steady throughout the year, according to the data obtained from 2000, 2004, 2007, and 2008. There seems to be a trend which shows elevated levels of TSS, around February, May, and November of each year. There was also a spike in concentration in April 2000.

3.2 Water Quality Test Results for Oxygen Depletion

Dissolved Oxygen is a very important indicator of a water body's ability to support aquatic life. Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Aquatic life depends on oxygen to breathe, as does all life. Fish "breathe" by absorbing dissolved oxygen through their gills. Natural stream purification processes require adequate oxygen levels in order to provide for aerobic life forms. As dissolved oxygen levels in water drop below 5.0mg/L, aquatic life may be put under stress. Oxygen levels that remain below 1-2 mg/L for an extended period of time can result in fish kills.

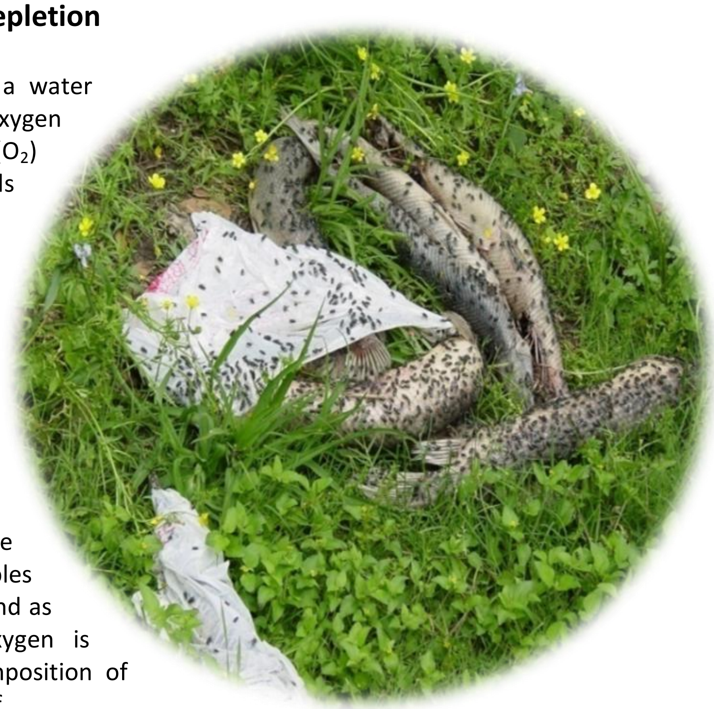


Figure 19 Dead fish sprawled out on the bank of Bayou Grosse Tete

For oxygen to be available in water, it has to be dissolved first. Oxygen dissolves in water tiny air bubbles are formed by the churning or movement of water, and as a byproduct of aquatic plant photosynthesis. Oxygen is removed from the water by respiration and decomposition of organic matter. Rivers that have excess amounts of nutrients can become low in dissolved oxygen, due to over production of algae and subsequent die-off and decomposition of algae.

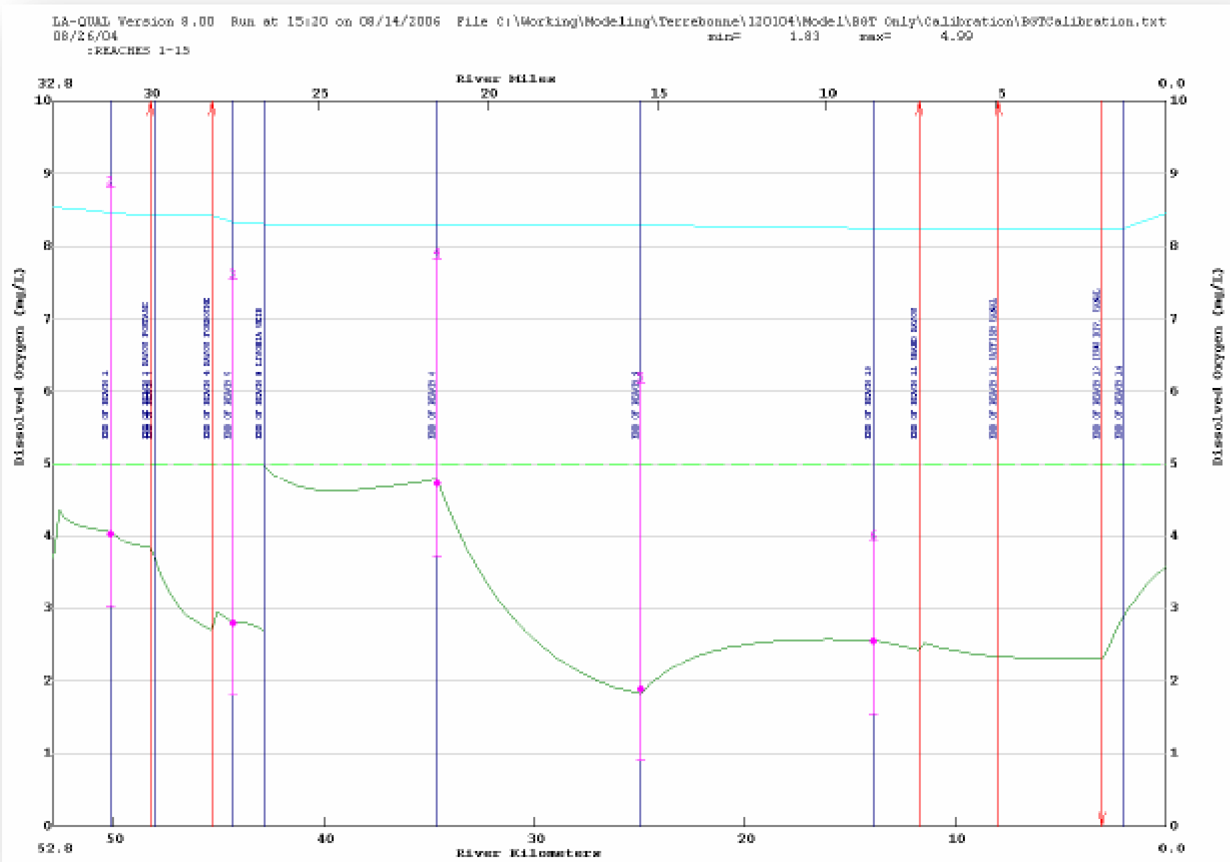
Total dissolved gas concentrations in water should not exceed 110 percent saturation. Concentrations above this level can be detrimental to aquatic life. Fish in waters containing disproportionate dissolved gases may suffer from "gas bubble disease". The bubbles or emboli block the flow of blood through blood vessels causing death. External bubbles (emphysema) can also occur and be seen on fins, on skin and on other tissue. A fish that is under stress caused by low oxygen levels in the water is more susceptible to poisoning by insecticides or heavy metals. Aquatic invertebrates are also affected by the “gas bubble disease” but at levels higher than those lethal to fish.

There are several factors that contribute to the concentration of dissolved oxygen. Some of the aspects include: volume and velocity of water flowing in the water body; climate and season; the type and number of organisms in the water body; dissolved or suspended solids; altitude; amount of nutrients in the water; organic wastes; riparian vegetation; and groundwater inflow. Dissolved oxygen is directly proportional to atmospheric pressure; therefore, as atmospheric pressure goes up, so does DO. In addition, as temperature goes down, D.O. goes up.

Sufficient dissolved oxygen is essential for good water quality. Oxygen is a necessary component to all forms of life. Natural stream purification processes require adequate oxygen levels in order to provide for aerobic life forms. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. The lower the concentration of the water, the greater the stress will be on that environment. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills. Natural variation of dissolved oxygen from one season to another is a given, as temperatures vary from season to season. Most slow-moving rivers and bayous in Louisiana exhibit low dissolved oxygen concentrations during the summer months.

Output from the calibration model showed that Bayou Grosse Tete was not meeting the DO standard of 5.0mg/L at any point in the modeled reaches. The lower concentration of DO in the Bayou Grosse Tete area is contributing to the fact that the bayou is not meeting its designated use for fish and wildlife propagation. See Figure 20: Calibration Model Dissolved Oxygen vs. River Kilometer, Bayou Grosse Tete.

Figure 20 Calibration Model Dissolved Oxygen vs. River Kilometer, Bayou Grosse Tete



Since the calibration model indicated that the dissolved oxygen standard was not being met through the majority of the water body; therefore, “No Load” summer scenarios were performed in addition to the traditional summer and winter projections.

The horizontal lime green line shows where the dissolved oxygen levels should be. The pink dots on the graph depict the points at which the dissolved oxygen levels were at the particular reach. All reaches had a dissolved oxygen level below 5.0 mg/L.

3.3 Water Quality Test Results for Nutrients

Figure 21 Disturbed bank of Bayou Grosse Tete; hardly any vegetation;

Eutrophication is defined as the increased rate of primary production, often due to increased nutrient inputs. There have been debates on how much phosphorus- or nitrogen-based compounds contribute to eutrophication at any specific time and/or locale. In either case, however, it is clear that both phosphorus and nitrogen loadings to aquatic systems have increased since pre-industrial times because of increased inputs of phosphate and nitrate-based fertilizers, atmospheric nitrogen deposition and domestic/agricultural waste water runoff.

Nutrient enrichment can result in increased plant/algal biomass in an aquatic ecosystem. The increase in algal biomass can lead to decreased light levels that hinder benthic photosynthetic processes and higher biological oxygen demand (BOD), due to respiration of the large algal biomass and/or consumer biomass (e.g., bacteria and grazers).

Increased amounts of phosphorous and nitrate/nitrite are among the six impairments to Bayou Grosse Tete. Most lakes and streams in Louisiana have high levels of eutrophication. Usually, runoff from agricultural use has significantly higher nutrient concentrations than drainage waters from forested watersheds. Increased nutrient levels may be a result from fertilizer application and animal wastes. Nutrient concentrations are generally proportional to the percentage of land in agricultural use and inversely proportional to the percentage of the land in forested use (EPA, 1977).

Nutrients are essential to plant growth in a water body, but over-enrichment leads to excessive algae growth, an imbalance in natural nutrient cycles, changes in water quality and a decline in the number of desirable fish species (LDEQ, 2000). When phosphorous and nitrogen are applied in excess, they may move until they reach a water body, and in this case, may become harmful to the water body's organisms. Soluble nutrients may reach surface waters through runoff and ground waters through percolation, while others may be adsorbed onto soil particles and reach surface waters with eroding soil. Aspects that influence nutrient losses are precipitation, temperature, soil type, kind of crop, type of conservation practices used, nutrient mineralization, and de-nitrification.

Nitrogen is naturally present in soils, but is sometimes added to increase crop production. Nitrogen is measured as Total Kjeldahl Nitrogen (T.K.N), which is the sum of organic nitrogen (Norg) and ammonia nitrogen (NH_3-N). Organic nitrogen is the nitrogen incorporated into organic compounds, mainly as unassimilated proteins. The action of bacteria on organic compounds degrades the material and releases ammonia (NH_3). Oxidation on ammonia by bacteria such as *nitrosomonas* results into nitrite (NO_2^-) formation, which when oxidized by *nitrobacter* bacteria becomes nitrate (NO_3^-). Other sources of nitrates that may be present in water runoff may include municipal and industrial wastewater, septic tanks, feed lot discharges, animal wastes (including birds and fish) and discharges from car exhausts.

Phosphorus can also contribute to the eutrophication of both freshwater and estuarine systems. The phosphorus concentration of soil is very low. It can be found in the soil in dissolved or particulate forms. Runoff and erosion can carry the excess applied phosphorus to the nearby water bodies. Dissolved inorganic phosphorus is most likely the only form directly available to algae. Particulate and organic phosphorus delivered to the water bodies may later be released and made available to algae when bottom sediment of a stream becomes anaerobic, causing water quality problems.

3.4 Water Quality Test Results For Other Impairments

Bayou Grosse Tete's impairments are dissolved oxygen, pesticides (atrazine), nutrients (nitrite/nitrate, phosphorous), pathogens (total and fecal coliform), and salinity/TDS/chlorides (total dissolved solids). All of these play a part, whether small or big, in effecting the concentration of dissolved oxygen levels.

Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. This includes anything present in water other than the pure water molecule and suspended solids. Dissolved solids may come from inorganic materials such as rocks and air that may contain calcium bicarbonate, nitrogen, iron phosphorous, sulfur, and other minerals. Many of these materials form salts, which are compounds that contain both a metal and a nonmetal. Some dissolved solids may also come from organic sources such as leaves, silt, plankton, and industrial waste and sewage. Other sources come from runoff from urban areas, road salts used on the street during the winter, and fertilizers and pesticides used on lawns and farms. Water may also pick up metals such as lead or copper as they travel through pipes used to distribute water to consumers.

Atrazine is a widely used herbicide, with its most extensive use for corn and soybeans in Illinois, Indiana, Iowa, Kansas, Missouri, Nebraska, Ohio, Texas, and Wisconsin. It is a white, crystalline solid organic compound, and is utilized to control broadleaf and grassy weeds. Atrazine may be released into the environment in wastewater from manufacturing facilities and through its use as an herbicide. It was the second most frequently detected pesticide in EPA's National Survey of Pesticides in Drinking Water Wells. Microbial activity and other chemicals may breakdown atrazine in soil and water, particularly in alkaline conditions. Sunlight and evaporation do not reduce its presence. It may bind to some soils, but generally tends to leach to ground water. Effective in 1993, its uses were greatly restricted. The pesticide atrazine was cited as a possible cause of impairment for Bayou Grosse Tete.

Figure 22 A stretch of Bayou Grosse Tete

Fecal coliform bacteria are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals, and can enter water bodies from human and animal waste. If a large number of fecal coliform bacteria (over 200 colonies/100 milliliters (ml) of water sample) are found in water, it is possible that pathogenic (disease- or illness-causing) organisms are also present in the water. Fecal coliform by themselves are usually not pathogenic; they are indicator organisms, which means they may indicate the presence of other pathogenic bacteria. Pathogens are typically present in such small amounts, that it is impractical to monitor them directly.

Swimming in waters with high levels of fecal coliform bacteria increases the chance of developing illness (fever, nausea or stomach cramps) from pathogens entering the body through the mouth, nose, ears, or cuts in the skin. Diseases and illnesses that can be contracted in water with high fecal coliform counts include typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections. Fecal coliform, like other bacteria, can usually be killed by boiling water or by treating it with chlorine. Washing thoroughly with soap after contact with contaminated water can also help prevent infections.

There are many sources and factors that affect the concentration of fecal coliform bacteria. Community waste water and septic system effluent are sources of bacteria. Fecal coliform is present in human waste. The bacteria

Figure 23 Sampling site of LDEQ Field Survey Team: Bayou Grosse Tete

travel down the drains in our houses and businesses and can enter streams from illegal or leaky sanitary sewer connections, poorly functioning septic systems, and poorly functioning wastewater treatment plant effluent. Fecal coliform is also found in the wastes produced by domestic animals and wildlife. This can be a serious problem in waters near cattle feedlots, hog farms, dairies, and barnyards that have poor animal keeping practices and where waste is not properly contained. In urban areas, fecal coliform can be contributed to surface water by dogs, cats, raccoons, and birds when it is carried into storm drains, creeks, and lakes during storms. Bacteria grow faster at higher temperatures. The growth rate slows drastically at very low temperatures. Pathogens, namely fecal coliform, were cited as possible causes of impairment for Bayou Grosse Tete, stemming from on-site treatment systems.

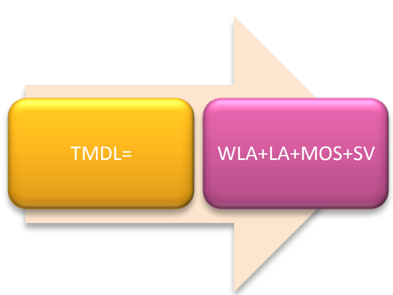
4.0 TMDL FINDINGS

Input data for the calibration model was developed from data collected during September of 2001, in which an intensive survey of Bayou Grosse Tete was performed. Data was collected by LDEQ and USGS at monitoring stations in the watershed; the LDEQ Reference Stream Study; permits and permit applications for each of the point source dischargers; USGS drainage area and low flow publications; and data garnered from several previous LDEQ studies on nonpoint source loadings. A satisfactory calibration was achieved for the main stem. For the projection models, data was taken from the current municipal discharge permits, current applications and ambient temperature records. The Louisiana Total Maximum Daily Load Technical Procedures, 05/26/2005, were followed in the study.

Bayou Grosse Tete, subsegment appeared on the 2002 and 2004 303(d) lists. It was found that it was not supporting its designated uses of primary contact recreation and fish and wildlife propagation. It was, however, "fully supporting" its designated use of secondary contact recreation. The TMDL for Bayou Grosse Tete addresses the suspected cause of impairment, organic enrichment/low dissolved oxygen. It establishes load limitations for oxygen-demanding substances and goals for reduction of those pollutants. LDEQ's position is that when oxygen demanding substances are controlled and limited in order to ensure that the dissolved oxygen criterion is supported, nutrients are also controlled and limited. The implementation of the Bayou Grosse Tete TMDL through the implementation of best management practices are going to be used to control and reduce runoff of soil and oxygen-demanding pollutants from nonpoint sources in the watershed, and will also control and reduce the nutrient loading from those sources.

In short, a TMDL is calculated using the following equation:

<u>WHERE;</u>
SV= Seasonal Variation
WLA= Waste Load Allocation
MOS= Margin of Safety
LA= Load Allocation



What is the TMDL Process?

1. Identify waters that do not meet water quality standards. In this process, the state identifies the particular pollutant(s) causing the water not to meet standards.
2. Prioritize waters that do not meet standards for TMDL development (for example, waters with high naturally occurring "pollution" will fall to the bottom of the list).
3. Establish TMDLs (set the amount of pollutant that needs to be reduced and assign responsibilities) for priority waters to meet state water quality standards. A separate TMDL is set to address each pollutant with concentrations over the standards.

4.1 Dissolved Oxygen Results

The primary numeric standard for the TMDLs used in this report is the DO standard of 5mg/L year round. The dissolved oxygen concentrations were calculated based on the results of the LA-QUAL water model. Bayou Grosse Tete had a good calibration to flow, effective BOD, DO, and chlorophyll A. An acceptable calibration was achieved for chlorides and sulfates. Output from the calibration model shows that Bayou Grosse Tete was not meeting the D.O. standard of 5.0 mg/L at any point in the modeled reaches. Figure 20 shows this information, page18.

4.2 Nonpoint Sources

Nonpoint source loads which are not associated with a flow are input into this part of the model. These can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, CBOD and NBOD loads. Over the years LDEQ has collected data on heavily impacted streams in Louisiana. These data were reviewed and summarized by Smythe and Waldon. LDEQ determined that these types of loading were part of the Reference Stream work and these loads have also been used to determine some of the input data. In general the total NPS load exceeds the reference stream load. The manmade portion of the NPS loading is the difference between the calibration load and the reference stream load where the calibration load is higher.

		Data Type 19-Non Point Sources		
Reach	Reach Name	Length of Reach,km	UCBOD1, kg/day	Data Source
1	False River Canal-Frisco Bridge(LA 411)	2.69	225.0	Calibration
2	Frisco Bridge(LA 411)-Bayou Portage	1.89	175.0	Calibration
3	Bayou Portage-Unnamed Canal	0.2	25.0	Calibration
4	Unnamed Canal-Bayou Fordoche	2.75	225.0	Calibration
5	Bayou Fordoche-Livonia Bridge (Bridge Rd.)	1.01	75.0	Calibration
6	Livonia Bridge(Bridge Rd.)-Concrete Weir	1.45	175.0	Calibration
7	Concrete Weir	0.01	0.0	Calibration
8	Concrete Weir-Maringouin Bridge	8.21	260.0	Calibration
9	Maringouin Bridge-Rosedale Bridge	9.68	600.0	Calibration
10	Rosedale Bridge-Sidney Rd. Bridge	11.05	1075.0	Calibration
11	Sidney Rd. Bridge-Grand Bayou	2.22	275.0	Calibration
12	Grand Bayou-Catfish Canal	3.75	325.0	Calibration
13	Catfish Canal-ICWW Diversion	4.91	425.0	Calibration
14	ICWW Diversion-LA 77 Boat Launch	1.06	70.0	Calibration
15	LA 77 Boat Launch-Intracoastal Waterway	1.96	125.0	Calibration

Table 3 Nonpoint Sources, Bayou Grosse Tete

Figure 24 Erosion in a ditch in an agricultural field that drains into Bayou Grosse Tete

4.3 Other Results

Since the calibrated models indicated that the DO criterion was not being met through the majority of the water body, “No Load” summer scenarios were performed in addition to the traditional summer and winter projections.

4.3.1 No Load Scenario

Under this scenario, the SOD, NPS, headwater and wasteload values were reduced to reference stream values except where the calibration value was less than the reference stream value. Several reduction runs were made after the original No Load run revealed that 100% removal of man-made nonpoint sources would result in a minimum DO of 5.20 mg/L in Bayou Grosse Tete. See Figure27, page24.

4.3.2 Summer Projection

A summer critical season projection was run against the current DO standard of 5.0 mg/L for Bayou Grosse Tete. To meet the standards, a 95% reduction to man-made loading would be required. This yields a model output minimum DO of 4.81 mg/L. See Figure28, page24.

Figure 25 Murky water of Bayou Grosse Tete

4.3.3 Winter Projection

A projection for the winter critical season was also run against the DO standard of 5.0 mg/L for Bayou Grosse Tete. Applying a 95% reduction to man-made loading in the winter season, results in a minimum DO of 7.19 mg/L. A graph of the dissolved oxygen concentration versus river kilometer for the winter projection is presented in Figure 29, page25.

Figure 26 Notice the sheen on the bayou’s surface

Figure27 Bayou Grosse Tete No Load scenario with 100% Removal of Man-Made NPS Loads

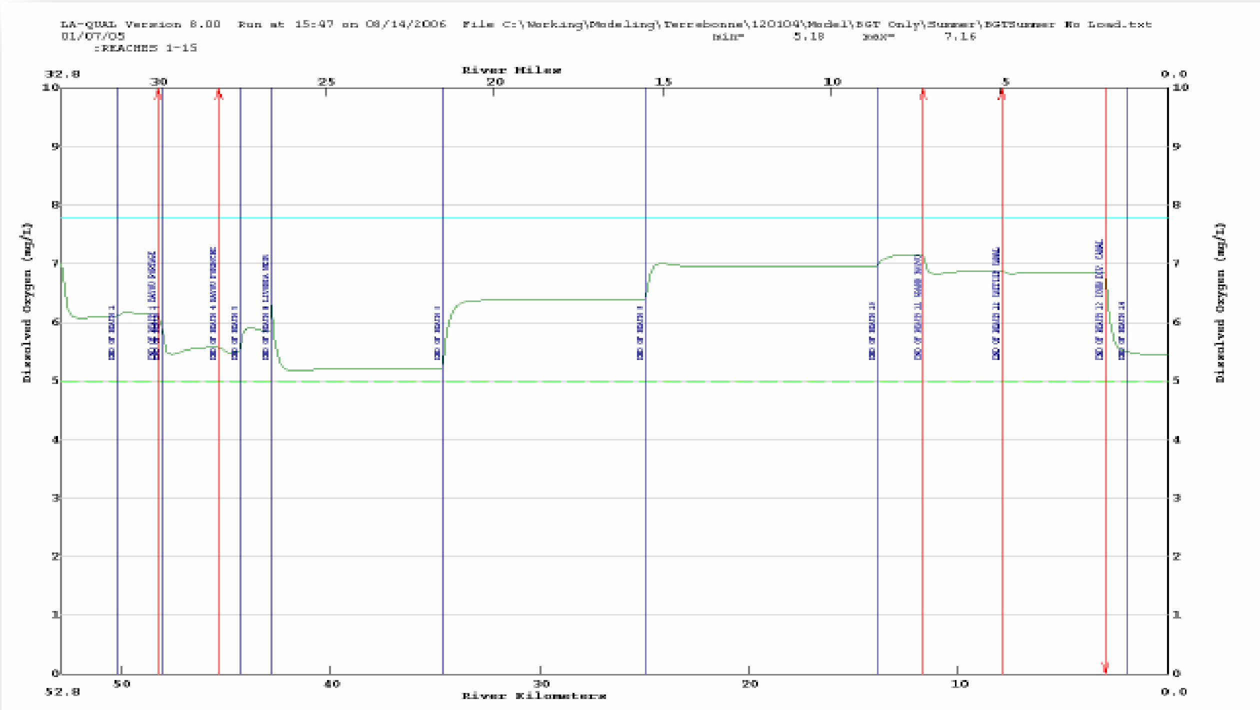


Figure 28 Bayou Grosse Tete Summer Projection at 95% Removal of Man-Made Loads

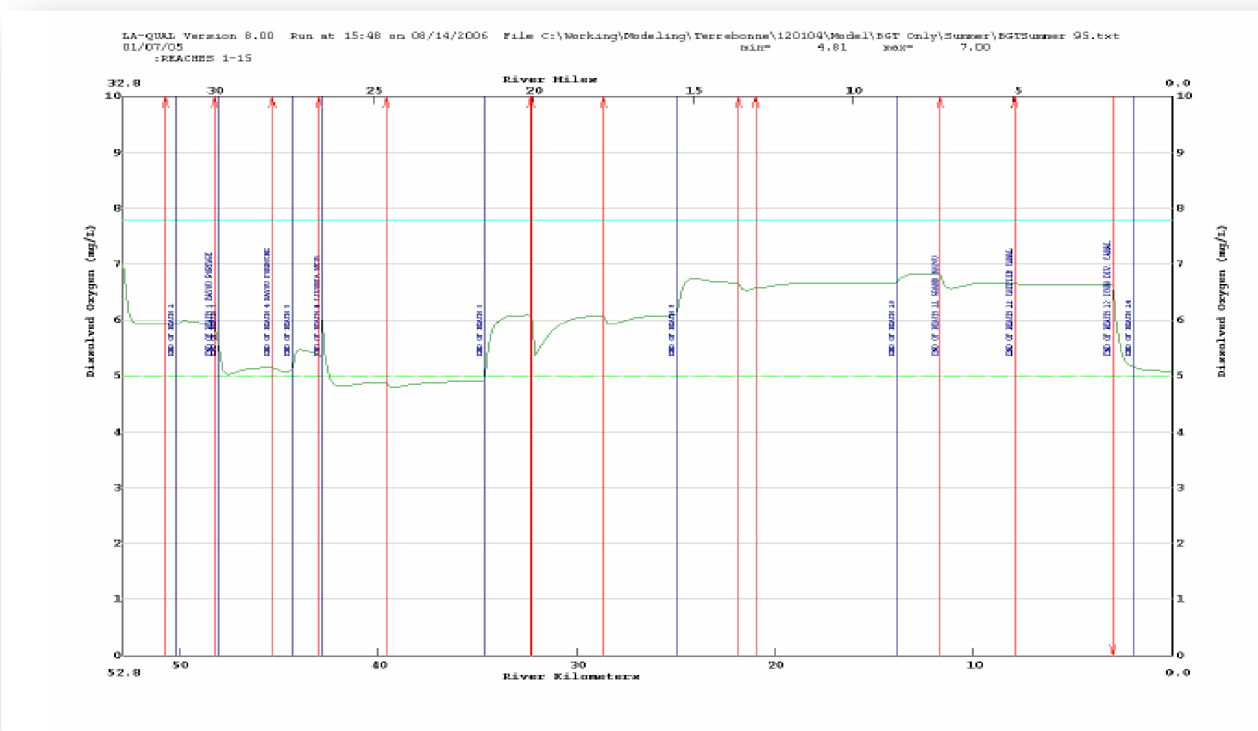
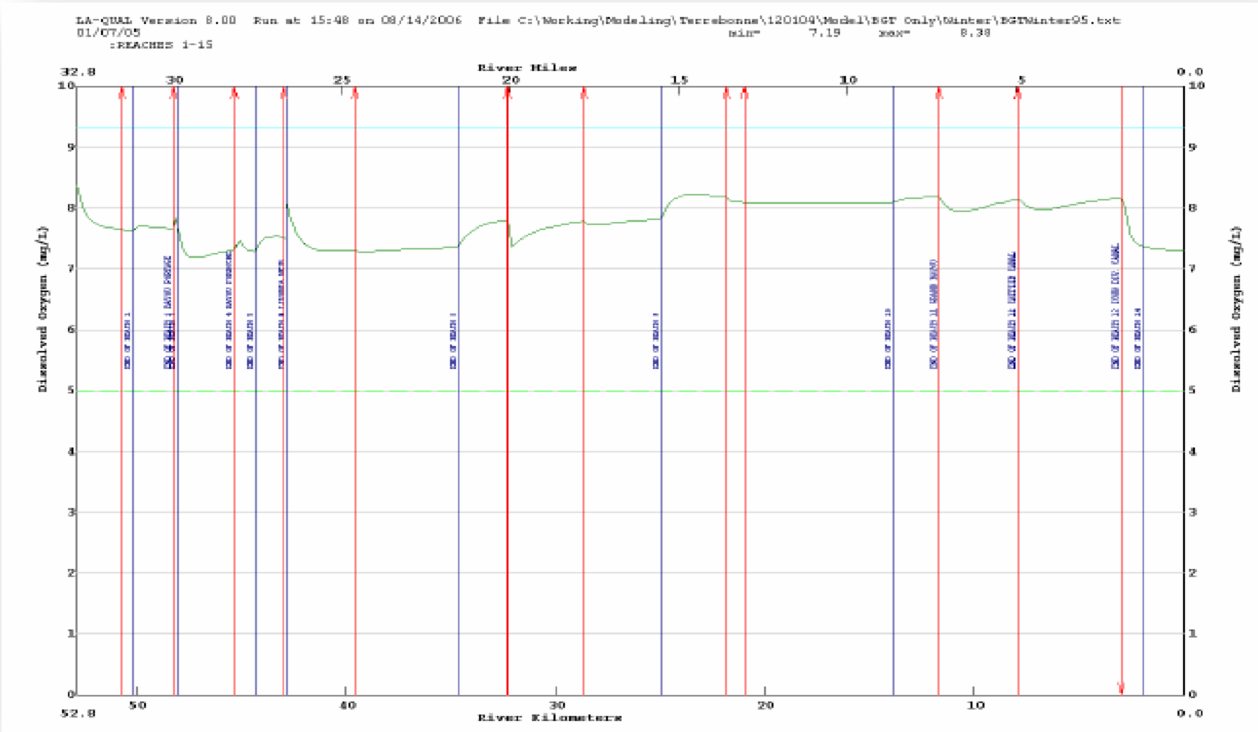


Figure 29 Bayou Grosse Tete Winter Projection at 95% Removal of Man-Made Loads



The TMDLs for the biochemical oxygen demanding constituents (BOD and SOD), have been calculated for the summer and winter critical seasons. The TMDLs for the Bayou Grosse Tete watershed were set equal to the total stream loading capacity. They are presented in the figure below.

Allocation	**Summer**		**Winter**	
	% Reduction Required	May-Oct (lbs/day)	% Reduction Required	(Nov-Apr) (lbs/day)
Point Source WLA	0	57	0	57
Point Source Reserve MOS=20%		15		15
Natural NPS LA	0	7,270	0	5,627
Manmade NPS LA	95	666	95	507
Manmade NPS Reserve MOS Summer=20% Winter=20%		165		126
TMDL		**8,173**		**6,332**

Table 4 Total Maximum Daily Load (Sum of UBOD and SOD) for Bayou Grosse Tete (From LDEQ TMDL Report 2006)

***Note 1:UBOD as stated in this allocation is Ultimate BOD.
UBOD to BOD_5 ratio=2.3 for all treatment levels
Permit allocations are generally based on BOD_5***

The results of projection modeling for Bayou Grosse Tete show that the water quality standard for dissolved oxygen of 5.0 mg/L can be maintained during the summer critical season with a 95% reduction in man-made pollution. The existing point sources have no impact on the main stem of Bayou Grosse Tete and require no changes to their permitted charges.

Achieving a 95% reduction of all man-made loading within a watershed is not a feasible goal. The Bayou Grosse Tete system has been irretrievably altered by weirs, diversions and dredging projects. LDEQ suggests that criteria be modified to suit these changes to the watershed. It is important to realize that the 95% load reduction goal is based on reductions for critical conditions. In reality, the highest temperatures occur in July-August, the lowest stream flows occur in October-November, and the maximum point source discharge occurs following a significant rainfall, i.e., high flow conditions. The summer projection model is established as if all these conditions happened at the same time. LDEQ has been working on a Use Attainability Analysis for the Barataria and Terrebonne basins in hopes of setting realistic criteria for the areas waterbodies. Until then, it is recommended that best management practices be applied to the area, in hopes of improving the water quality of Bayou Grosse Tete.

4.4 What is a Use Attainability Analysis?

Designated uses can be changed or removed with appropriate analysis and documentation. To support making such a change, a State or Tribe may be required to conduct a "use attainability analysis." A use attainability analysis is a structured scientific assessment of the factors affecting the attainment of the use, which may include physical, chemical, biological, and economic factors.

Setting water quality goals through assigning "designated uses" is best viewed as a process for states and tribes to review and revise over time rather than as a one-time exercise. A key concept in assigning designated uses is "attainability," or the ability to achieve water quality goals under a given set of natural, human-caused, and economic conditions. The overall success of pollution control efforts depends on a reliable set of underlying designated uses in water quality standards. EPA issued the *Plan for Supporting States and Tribes on Designated Use Issues in 2004*, in an effort to make designated uses a priority, which called for:

- More outreach, training, workshops, and other support for states and tribes on critical issues regarding designating appropriate uses; and
- Continued discussions with stakeholders on designated use issues.

Ultimately, whenever a use change is contemplated, there should be thoughtful and informed public involvement in the process and throughout the process. States should communicate to the public about use changes early in the process and EPA should publicly support the states' actions to engage the local community in these discussions of what is attainable. These are important decisions, and the best decisions reflect consideration of all perspectives.

4.4.1 Dissolved Oxygen Criteria Revisions for the Barataria and Terrebonne Basins

Nationally recommended dissolved oxygen (DO) criteria of 5 mg/L for freshwater and marine and 4 mg/L for estuarine waters are the current criteria in Louisiana, except where site-specific revisions have been made. For many Louisiana water bodies, natural, physical conditions (such as lack of slope and re-aeration potential) prevent attainment of the current nationally-based DO criteria. However, nationally recommended criteria are inappropriate for many Louisiana waterbodies where dissolved oxygen is low due to natural conditions. The Barataria and Terrebonne Basins in southeast Louisiana is one such area where levels of dissolved oxygen in ambient surface waters are naturally low.

Because incorrect criteria can result in erroneous use impairment decisions that impact a multitude of the State's water quality programs (e.g., total maximum daily load determinations, wastewater permitting, implementation of best management practices to reduce non-point source pollutant loads), it is critical to establish appropriate and protective DO criteria that are supportive of fish and wildlife propagation in these regions. Therefore, a Use Attainability Analysis (UAA) was conducted to support the development of ecoregion-based dissolved oxygen criteria for the Barataria and Terrebonne Basins. The results presented in the Barataria and Terrebonne UAA indicates that the currently adopted dissolved oxygen criteria are inappropriate for some waterbodies in the Barataria and Terrebonne Basins. The biological data collected, supports that in these ecoregions, diverse fish species are abundant in reference areas with naturally occurring, seasonal periods of low dissolved oxygen, and therefore, the fish and wildlife propagation use is supported.

5.0 IDENTIFICATION OF HIGH PRIORITY AREAS

These areas were selected based on the land use type and water quality information within the Bayou Grosse Tete Watershed. High priority areas for this watershed are mainly agricultural fields draining into ditches that subsequently drain into the bayou; septic systems draining into the bayou or animal waste; forested areas; urban/residential developments; and areas affected by hydromodification. All of these sources play a part, whether small or big, in effecting the concentration of dissolved oxygen levels. These sources are a high priority for a broad array of conservation activities, which include at least one of the following: watershed-level protection efforts, restoration activities, reforestation of banks and riparian areas with native vegetation, livestock management, maintenance or restoration of natural flow and temperature regimes, protection of surrounding lands through conservation easements or land acquisition, and repair, replacement and proper maintenance of on-site sewage systems.

It is important to realize that the high priority areas list is only a starting point to guide conservation efforts. Additional information on land cover, land use change, nearness to existing protected areas, water quality, location of impoundments and other factors should also be considered when defining conservation priorities. Foremost, many of these "non high-priority" waters may be added to the list in the future as new information becomes available. Similarly, because of the inherent connectivity in aquatic and coastal ecosystems, degradation of one system may impact another.

Figure 30 Forested area along Bayou Grosse Tete

6.0 SOURCES OF NONPOINT SOURCE POLLUTION LOADING

Nonpoint source (NPS) pollution can directly or indirectly impair the quality of water of a given water body, which can in turn cause the water body to be deemed unacceptable for its designated uses. To maintain allowable water quality standards for Bayou Grosse Tete, it is imperative that the specific NPS pollution sources are discovered and reduced. Nonpoint source pollution in Bayou Grosse Tete may stem from innumerable sources within the watershed including agriculture, urban/built-up land, forestry, hydromodification, and even unmaintained septic systems.

6.1 Forestry

About 50.6% of the total surface area in Bayou Grosse Tete is comprised of forest area. There are several diverse forest types in that area, including: wetland forest deciduous, wetland s/s mixed, upland forest evergreen, upland forest deciduous, wetland s/s deciduous, upland s/s mixed, upland forest mixed, upland s/s deciduous, and upland s/s evergreen. Wetland forest deciduous is the largest forest type, encompassing more than half of the forest region. A deciduous forest is a forest containing deciduous plants and they exist where temperatures are mild and rainfall is abundant. Deciduous means "temporary" or "tending to fall off" (deriving from the Latin word *decidere*, to fall off). In a more specific sense deciduous means the dropping of a part that is no longer needed or will fall away after its use is finished.

Forested areas contribute a fair share of non point pollution, which may be caused by water movement over and through the surface of the land. The runoff picks up and transports natural and man-made pollutants, and they are then transported into rivers, streams, lakes, wetlands, coastal waters, and ground water. Herbicides, insecticides, and fungicides are used to control forest pests and undesirable plant species, but can be toxic to aquatic organisms. Pesticides that are applied to foliage or soils, or are applied by aerial means, are most readily transported to surface waters and ground waters. Some pesticides with high solubility's can be extremely harmful, causing either acute or chronic effects in aquatic organisms, including reduced growth or reproduction, cancer, and organ malfunction or failure. Other "chemicals" that may be released during forestry operations include fuel, oil, and coolants used in equipment for harvesting and road-building operations.

6.1.1 The Purpose of Wetland Forest Areas

The biogeochemical functions of coastal wetland forests maintain and improve water quality by transforming and retaining nutrients and pollutants, which is a potentially important ecosystem service in coastal Louisiana. The anaerobic conditions in the wetland drive the microbial conversion of nitrate (NO_3^-) to N_2 or NO_2, effectively removing NO_3^- from the system. Phosphorus and metals are generally attached to suspended particles and retained through wetland sedimentation processes. At the watershed scale, this ecosystem service links coastal wetland forests to surrounding upland ecosystems (pollution sources) and protects downstream aquatic ecosystems through hydrologic pathways that extend beyond the wetland perimeter.

Figure 31 Dead vegetation—maybe from pesticides; nutrients in water

Although wetlands only comprise approximately four percent of the Earth's land area, they store almost 33% of the soil organic matter worldwide, constituting the largest global soil carbon reservoir. High net primary production in wetlands combined with slowed decomposition of organic matter under anaerobic conditions results in high soil carbon densities. Carbon dioxide and methane account for 80% of the global warming potential of all greenhouse gases (IPCC, 1996); therefore, the release of these two gases from wetlands can have significant impacts on global climate change. When wetlands are drained and soil processes switch from anaerobic to aerobic, organic carbon is more rapidly oxidized to carbon dioxide and the basic function of the wetland changes from being a carbon sink to a carbon source.

Figure 32 Gar Fish swimming on surface of water to obtain oxygen (shown inside of the circles)

Figure 33 Plowing very close to of ditch and road; bare dirt between agriculture field and ditch

Forested wetlands provide numerous benefits to our country and its citizens and deserve special attention and protection. Over 33 million acres of forested wetlands containing $8 billion in standing timber are found in the Southeast alone. Some of our forests provide crucial wintering habitats for a great number of migratory birds, spawning and nursery grounds for game fish and associated aquatic invertebrates, and habitats for many other mammals, reptiles and amphibians. Most importantly, forested wetlands ease the effects of seasonal floods and provide clean, quality water.

Forested wetlands are uniquely suited to mitigate the negative impacts of nonpoint source pollution. Their landscape position and biogeochemical properties give them both the opportunity and mechanisms to alter pollutant loadings to aquatic ecosystems. However, they can not eradicate all of the pollution, including the dead leaves, decomposed trees and organic matter by themselves. The aforementioned waste, along with other nonpoint pollution that may contribute to the area is carried into the bayou during storm events. Harvesting may be one way that pollution is increased in this area, and care should be taken to ensure proper forestry best management practices.

Figure 34 Drainage ditch cut directly through freshly tilled Ag field and right into ditch so that it can drain straight into Bayou Grosse Tete

The lower portions of Bayou Grosse Tete are primarily undeveloped, forested, and wooded. The problems occurring in this area, (i.e. murky water, little or no fish), are being caused by actions taking place else where. During the site visit to the

Bayou, it was observed that the gar fish were coming to the surface of the water to obtain oxygen. Gar fish inhabit sluggish, sometimes poorly oxygenated water, as found in Bayou Grosse Tete. They are able to tolerate poor water quality by breathing through their air bladder. The water level in this area was very shallow, and contained thick riparian vegetation. This is good, because it keeps the temperature down and holds the bank in place.

Figure 35 Vegetated ditch draining Ag field that leads to the bayou; good example of what draining ditch is supposed to look like!

6.2 Agriculture/Cropland/Grassland

Nonpoint source pollution is a key obstacle affecting the water quality in Louisiana. Agriculture contributes to a significant portion of non point source water pollution, transporting sediment, pesticides, animal waste, fertilizer, nutrients, pathogens, and salts into waterways with surface runoff.

6.2.1 Nutrients

Agricultural Lands in Bayou Grosse Tete account for about 43.5% of the area, and is the second largest land use of the subsegment. The Village of Grosse Tete practices row crop agriculture. Some of the crops grown in the area are soybeans, sugarcane with cotton, wheat, pasture/hay, and corn. Crops need nutrients to grow, and because of this, various types are applied to achieve this. Nutrients such as phosphorus, nitrogen, potassium, manure, sludge, irrigation water, legumes, and crop residues are applied to enhance production. The problem with row crop agriculture is that these crop residues are draining into ditches, and there aren't any grass filter strips or other vegetation around to absorb the runoff. For Bayou Grosse Tete, these nutrients are coming from tributaries and man-made-canals that are draining the agricultural fields and are then being dumped into the Bayou. These added nutrients can cause surplus plant growth, which reduces swimming and boating opportunities, creates a foul taste and odor in drinking water, and kills fish. On June 11th observations showed that many of the sugar cane fields were noted as having no buffer zones around them, only dirt; therefore, the runoff from these fields were draining directly into the nearby ditch and then into the

Figure 37 Soybeans planted inside of ditch and to the edge of the road

Figure 36 Duck potato plant in canal; great filtering plant

bayou. It was also noted that in a number of instances, the soybean fields, along with the sugar cane fields were actually planted in the fields as well as inside of the ditch, directly next to the edge of the road. In another sugar cane field down the road, a drainage ditch was cut so that all of the sediment draining from the fields would drain into the ditch, which drains straight into the bayou. The field was also tilled up right until the edge of the ditch. There was no vegetative buffer, so until they put the vegetation back, when it rains, the field will drain not only into the ditch, but also into the bayou. To help with the aforementioned problems, farmers can implement nutrient management plans which help maintain high yields and save money on the use of fertilizers while reducing NPS pollution.

There were, however a few good details noticed, for example: There was a canal that drained an agricultural field that was covered with duck potato plants and elderberry, which are good filtering plants (Figure 36). There was also a heavily vegetated ditch draining an agricultural field that drained into the bayou (Figure 35). There was no water in either of the ditches, which means that the plants were doing a wonderful job of filtering the runoff from the adjacent fields; therefore, none of the runoff was entering the bayou.

Figure 38 Dead fish in bayou; oily glaze on water surface

6.2.2 Pesticides

Pesticides were listed as a possible source of impairment for Bayou Grosse Tete. Pesticides, along with herbicides, and fungicides are used to kill pests and control the growth of weeds and fungus. These chemicals can enter and contaminate water through direct application, runoff, wind transport, and atmospheric deposition. They can kill fish and wildlife, poison food sources, and destroy the habitat that animals use for protective cover. To reduce NPS contamination from pesticides, people can apply Integrated Pest Management (IPM) techniques based on the specific soils, climate, pest history, and crop for a particular field. IPM helps limit pesticide use and manages necessary application to minimize pesticide movement from the field. Methods of agricultural production may need to be improved to limit the impact of nonpoint source pollution on water quality. The presence of pesticides in surface water has become a concern for water treatment facilities, because they are required to test quarterly for several agricultural pesticides under the Safe Drinking Water Act. The Maximum Contaminant Level of some common agricultural pesticides has been exceeded in several watersheds across the country, causing added treatment to drinking water to ensure there are reductions in the contaminant level.

Figure 39 Water barrel without concrete pad

6.2.3 Irrigation

Irrigated and non-irrigated crop production was sited as a possible cause of impairment for Bayou Grosse Tete. Irrigation water is applied to enhance natural precipitation or to protect crops against freezing or wilting. Inefficient irrigation can cause water quality problems. For example, excessive irrigation can concentrate pesticides, nutrients, disease-carrying microorganisms, and salts in the top layer of the soil. In the Village of Grosse Tete, there is an abundance of channels and man-made-ditches that drain the cropland and pastureland; however, they run straight into the Bayou. Farmers can reduce NPS pollution from irrigation by improving water use efficiency. Actual crop needs can be measured with a variety of equipment.

Figure 40 Cattle grazing on pasture land next to ditch that drains to Bayou Grosse Tete

6.2.4 Animals

Confined and unrestricted animals, along with wild and even domestic animals are major sources of animal waste. Runoff from poorly managed facilities or wild animal feces can carry pathogens (bacteria and viruses), nutrients, and oxygen-demanding substances that contaminate Bayou Grosse Tete, causing major water quality problems. Ground water can also be contaminated by seepage. Unrestricted livestock access to streams is associated with many negative environmental effects. Livestock defecating in streams may deposit harmful pathogens in the stream. Poorly managed riparian grazing can lead to loss of streamside vegetation (cover), resulting in elevated stream water temperatures and increased nutrients and sediment in the stream. Grazing in the riparian zone and unrestricted stream access increases streambank instability and erosion and can potentially lead to changes in stream flow patterns. Discharges can be limited by storing and managing facility wastewater and runoff with an appropriate waste management system. For Bayou Grosse Tete, grazing animals, cattle, beef cow, horses, etc., are adding to the runoff from the fields, and it all drains into the Bayou—nutrients and fecal coliform.

On the site visit on June 11th, a number of watering barrels for farm animals did not have concrete pads. However, they had lots of grass around the barrels, so it is unlikely that runoff would be reaching the ditches. There were also many dogs running around unleashed; a dog was even observed resting in the bayou!

Figure 41 Neighborhood dog sitting in Bayou Grosse Tete! Source of fecal content?

Figure 42 Illegal dumping grounds on banks of Bayou Grosse Tete

6.2.5 Sedimentation

Sedimentation occurs when wind or water runoff carries soil fragment from an area, such as a farm field, and carries them to a water body, such as a stream or lake. During the site visit on June 11th, an area was sighted in which it was evident that the water in that area was once high. It was apparent that the water level at one time rose and settled out over the bank, and either over time, or suddenly, the water elevation dropped, leaving behind soft, broken dirt on the bank and eroded particles in the bayou. At this point along Bayou Grosse Tete, there is no flow. An excess of sedimentation clouds the water, which in turn, reduces the amount of sunlight reaching aquatic plants; covers fish reproduction areas and food supplies; and blocks the gills of fish. In addition, other pollutants such as phosphorus, pathogens, and heavy metals are often attached to the soil particles and end up in the water bodies with the sediment. Farmers and ranchers can reduce erosion and sedimentation by 20 to 90 percent by applying management measures to control the volume and flow rate of runoff water, keep the soil in place, and reduce soil transport.

Figure 44 Sedimentation on water's edge of Bayou Grosse Tete

Figure 45 Heavy sediment depositions along bank of Bayou Grosse Tete

Figure 43 Expansive area of sediment deposits along Bayou Grosse Tete

Figure 46 Close up picture of sediment deposits

Figure 47 Sediment, logs, and trash deposits under bridge in the Town of Rosedale

There is a bridge in the Town of Rosedale that has an abundance of sediment beneath it. It is easy to see that with every storm, the water level comes up and deposits sediment and silt onto the banks. Upstream from there, there is usually a log jam where trash builds up behind fallen trees, tires, trash, etc. There is little or no flow in this area, the water is murky looking, and there is a lot of siltation.

Figure 48 Sediment deposits under bridge in the Town of Rosedale

Figure 49 Ditch sprayed with weed killer

6.3 Urban Areas/ Residential Development

Urban areas/built up land was sited as being only 4.5% of Bayou Grosse Tete's land use; However, it is important to note that that figure includes a two-mile stretch of homes and businesses along Bayou Grosse Tete. Therefore, those homes, though not many, may be depositing waste in close proximity, or into the bayou. Uncontrolled or treated runoff from urban areas and from construction activities can run off the landscape into surface waters. During the April 3rd site visit, road construction, and logging and oil field activities were noted to be occurring in close proximity to the Bayou. This runoff can include such pollutants as sediments, pathogens, fertilizers/nutrients, hydrocarbons, and even metals. Pavement and compacted areas, roofs, reduced tree canopy and open space increase runoff volumes that rapidly flow into our waters. This increase in volume and velocity of runoff often causes stream bank erosion, channel incision and sediment deposition in stream channels. In addition, runoff from these developed areas can increase stream temperatures that along with the increase in flow rate and pollutant loads negatively affect water quality and aquatic life.

Figure 50 New home built on bank of Bayou Grosse Tete

Figure 51 Truck partaking in logging activities in close proximity to Bayou Grosse Tete

Other common sources of urban pollution include improperly sited, designed and maintained onsite wastewater treatment (septic) systems, pet wastes, lawn and garden fertilizers and pesticides, household chemicals that are improperly disposed of, automobile fluids, and vehicle emissions. A common mistake of homeowners is to spray weed killer into ditches instead of simply mowing it. It's a mistake because a lot of those ditches may lead a body of water, and in this case, it does. A homeowner in the Village of Grosse Tete sprayed their ditch with a weed killer, and that ditch drains directly into Bayou Grosse Tete.

Fecal Coliform was sited as a suspected cause of impairment, namely from onsite treatment systems, for Bayou Grosse Tete. Inadequately treated human sewage is a source of fecal coliform bacteria and excess nutrients in streams and ground water. The discharge of untreated

Figure 52 Larger sized home in the Village of Grosse Tete that has two sewage pipes draining into a ditch that leads to the bayou

human sewage to waterways poses severe potential threats to human health. Untreated sewage contains bacteria (such as Salmonella), viruses, (such as Hepatitis A) and parasites (such as Giardia and Cryptosporidium) that are capable of causing disease. Some of these contaminants are infectious at very low levels of exposure. Sewage may also contain toxic chemicals dumped down drains. Studies show that this pollution has the potential to harm the health of those who swim in or drink from those waterways.

Figure 53 Another home with a larger sewage pipe draining into a ditch that drains into Bayou Grosse Tete; notice the lush green vegetation growing

During the April 3rd site visit, it was noted that some of the neighborhoods in Grosse Tete were not sewered; consequently, they are draining directly into Bayou Grosse Tete. Many pipes were seen jutting from the sides of homes and flowing right into the bayou—not just septic tanks, but any and all drainage from those homes are being deposited into the water. A newly constructed neighborhood was visited on June 11th, and it was noted that almost every house had a sewage pipe draining into the ditch in front of their home; the bigger homes had two sewage pipes draining into the ditch. Bugs were flying around, the drainage was green and brown, and there was nice green vegetation growing throughout the ditch. The ditch was constructed to flow right into the bayou, which is across the street; therefore, when a good rain comes along, all contaminates are flushed into the bayou. It was also observed that some of the residents were trying to build up their land by filling in the bank side with cinder blocks, steel beams, and trash. All debris was taken from a school site that had been torn down because it was suspected to have contained asbestos and lead. The homeowners are using these materials that are not only hazardous to the bayou, but also to their health. There was also another home that had old junk cars pilled up along the bayou. These cars are potentially leaking gas, antifreeze, rust, and anything else that flows from it into the Bayou. A bar and grill was also noted as sitting right on the bayou, and is most likely draining straight into it—grease, sewage, etc.

Figure 54 Residents backfilled bank side with cement blocks and steel beams salvaged from a demolished school, which may have contained asbestos and lead paint

6.4 Hydromodification

Legend has it that Bayou Grosse Tete means “Big Head”, to represent the five or six streams that join together to become Bayou Grosse Tete. The areas around Bayou Grosse Tete were initially agricultural areas. However, those areas have changed through the centuries to accommodate the changing times. Bayou Grosse Tete is a part of Iberville Parish. The parish has always had plenty of sugarcane and soybean fields, but through the years the hardwood timber industry, river commerce and now industrial development have been

Figure 55 A recreational area that sits on the edge of Bayou Grosse Tete

Figure 56 Tolbert Weir that crosses Bayou Grosse Tete

essential to a thriving parish economy. With the agricultural, timber, sawmill, and water commerce industries powering the economy, Iberville prospered into the 1960s. It was then that the chemical industry realized the many advantages that Iberville offered with its access to the Mississippi River, interstate travel, electrical power and hard-working people. When the Intracoastal Waterway was constructed, parts of Bayou Grosse Tete were cut off, resulting in a reduced level of flow throughout the Bayou. Now, silt and sediment is filling the Bayou in. The Intracoastal Waterway was a shortcut to the Gulf, so it was faster to cut through it than go around. As a result, many of the barges came through the area; they spun up sediment, and it settled to the bottom. During the site visit, in an area off of Hwy 77 called Horseshoe Bend, which is a checkpoint station used for hunting and fishing, an example of a problem resulting from the construction of the IntraCoastal Waterway was noted; the water in the area was moving upstream, which could have been a result of backwater; backwater in this sense, would mean that it could have rained in the area recently, and shallow parts of the Bayou were filling up fast, to make an equilibrium in the Bayou. It was also noted that North of I-110, the banks of the Bayou become steeper, which tells us that at some point, the channel was a greater body of water and that it has a greater flow capacity than it has now, because of the fact that the Bayou has been cut off. There is also a weir in Livonia, the Tolbert Weir that crosses Bayou Grosse Tete, where boats come to catch fish to sell them as crawfish bait. From the top of the weir to the bottom, is about a 5 ft distance. The weir prevents flow, resulting in trapping of pollutants, as seen just upstream of the weir, and low reaeration and reduced oxygen levels. Where LA 78 and LA 979 cross, oil, which may be swept from off of the roads, and dead fish were observed.

Figure 57 Tolbert Weir that crosses Bayou Grosse Tete

Today, the parish has six municipalities - Plaquemine, the largest city and capital of the parish, St. Gabriel, White Castle, Rosedale, Grosse Tete and Maringouin. It is experiencing an economic burst, with several chemical and industrial plants announcing new plant start-ups and expansions totaling well over $1 billion. Given the past history of the area, the Bayou Grosse Tete system has been irretrievably altered by weirs, diversions and dredging projects, which very well may account for the many problems that the Bayou is undergoing today.

7.0 NONPOINT SOURCE POLLUTION SOLUTIONS

The causes of nonpoint source pollution are diverse and may be non-specific in character. Therefore, control and prevention techniques may take many forms with the intention of addressing local conditions that are contributing to NPS pollution impacts. These techniques are typically called Best Management Practices (BMPs). A large variety of BMPs have been developed and modified by various groups and agencies over the last two decades to minimize or inhibit NPS pollution impacts. Best Management Practices may take many forms, including regulatory land use controls, pollution source controls, structural land use management practices, vegetative practices and activity management practices. On-going public education and increased awareness about NPS pollution impacts and prevention is extremely important to the success of monitoring and enforcement efforts to implement BMPs. Establishing goals in association with Best Management Practices to address nonpoint source pollution heightens awareness of NPS pollution problems. It can facilitate proactive and hands-on planning by the town and private developers that can lead to better management of NPS pollution impacts through earlier focus and recognition of potential problem situations. Early identification of NPS pollution impacts can help minimize or eliminate consequent adverse effects to the environment and to human health. BMPs are seldom employed alone. The average cost and load reductions were obtained from an employee of the LDAF/OSWC, and can be obtained from the NRCS eFOTG web page, http://www.nrcs.usda.gov/technical/efotg/ , unless otherwise noted (LDAF 2008); the numbers in parenthesis represent the practice code. The efficiency of many BMPs can be augmented by employing others which complement them. A summary of the effectiveness of favorable BMPs is provided in Louisiana's Nonpoint Source Management Plan (LDEQ, 2000). http://nonpoint.deq.louisiana.gov/wqa/default.htm

7.1 Forestry

Best Management Practices have proved to be successful in helping to meet water quality standards. A wetland's functions and values, such as flood protection, groundwater recharge and discharge, fish and wildlife habitat, recreation and other social benefits, can be maintained through the use of forestry BMPs.

Figure 58 Abandoned home in the Village of Grosse Tete

Forested wetlands can and should be managed to provide a multitude of benefits. Forest management programs should incorporate adequate measures to provide for proper soil and water conservation. Most streams originating in or flowing through our timberlands are sources for water supplies, recreation, and other uses. However, those same streams are being polluted by pesticides, herbicides, fertilizers, fire-retardant chemicals, organic matter and woody debris, and even by thermal pollution from increased water temperature where trees along streams have been removed. Increased temperatures influence dissolved oxygen concentration and bacterial populations in streams. Consequently, a plan should be put into place to maximize the efficiency of our forests, minimize traffic, preserve soil integrity, and protect water quality.

The recommended wetland forest Best Management Practices are listed below:

- Minimize the amount of soil on the road banks or roadsides that is exposed to soil erosion. To minimize problems, revegetate (using seeding or planting), or otherwise stabilize these areas as they are created. Use mixes of species and treatments developed and tailored for successful vegetation establishment for the region or area. Revegetation of areas of disturbed soil can successfully prevent sediment and pollutants associated with the sediment (such as phosphorus and nitrogen) from entering nearby surface waters. The vegetation controls soil erosion by dissipating the erosive forces of raindrops, reducing the velocity of surface runoff, stabilizing soil particles with roots, and contributing organic matter to the soil, which increases soil infiltration rates. Minnesota's Stewardship Incentives Program (SIP) estimated the costs of reestablishment of permanent vegetation to vary from $80.00/acre to $147.00/acre of disturbed area, depending on the type of vegetation used. According to the LDAF, conservation practice(322), channel bank vegetation, moderately to substantially decreases soil erosion on the streambank; slightly to moderately decreases damage to the soil due to sediment deposition; there's a moderate to substantial decrease in conveyances by sediment deposition and a moderate decrease in sediment accumulation; there's a moderate decrease in suspended sediment and turbidity in surface water; a slight to moderate decrease in harmful temperatures of surface water; and a moderate to substantial decrease in fish and wildlife habitat fragmentation. When using some form of channel stabilization(584), the research shows a moderate decrease in streambank erosion; there's a slight to moderate decrease in soil condition due to damage from sediment deposition; a slight to moderate decrease in excessive seepage; a slight decrease in conveyances by sediment deposition, sediment accumulation, excessive suspended sediment and turbidity in surface water, and harmful temperatures of surface water; and a slight to moderate decrease in fish and wildlife habitat fragmentation.

- Excess material and woody debris from road construction should be cleared from streams and drainage ways. Store, cover, and isolate construction materials, refuse, garbage, sewage, debris, oil and other petroleum products, mineral salts, industrial chemicals, and topsoil to prevent runoff of pollutants and contamination of ground water.

- When possible, trees should be directionally felled away from water bodies. Remove only tops and limbs which have fallen into any water body during harvesting.

- Hire a company to clean out old logs and fallen trees that are preventing flow and holding up trash in the Bayou; Currently, B & T Environmental is in the area cleaning out small sections of the Bayou.
  B & T Environmental Services specializes in field work in the environmental testing, monitoring and cleanup industry. Obstruction removal (500), according to LDAF, would slightly increase soil compaction; have a slight to moderate decrease in water quantity: inadequate outlets; there's a slight decrease in insufficient flows in water courses; and a moderate decrease in conveyances by sediment deposition and sediment accumulation.

- Carefully plan ground and aerial application to avoid direct and indirect entry of chemicals into streams and impoundments. Leave well marked buffer zones between target area and surface water.

Additional Louisiana Forestry best management practices can be found at http://www.ldaf.state.la.us/divisions/forestry/forestmanagement/best-management-practices.asp. Furthermore, the Recommended Forestry Best Management Practices for Louisiana manual has been and will continue to be an invaluable source of information and recommendations (LDEQ, 2000).

7.2 Agriculture

The Bayou Grosse Tete TMDL reported that pesticides, nutrients, and suspended solids are associated with crop production. Some of the crops grown in the area are soybeans, sugarcane, cotton, wheat, pasture/hay, and corn. To enhance production, nutrients such as phosphorus, nitrogen, potassium, manure, sludge, irrigation water, legumes, and crop residues are applied, but sometimes in excess. When this occurs, the nutrients gain entry into the water communities and cause pollution. To help minimize this situation, the following Best Management Practices are recommended in hopes of reducing the amounts of these pollutants entering Bayou Grosse Tete:

- Install riparian buffers. Riparian buffers are strips of grass, trees or shrubs established adjacent to streams, ditches, wetlands or other water bodies.

  A riparian buffer serves the following functions as it pertains to pollutants:
  - Trapping/removing sediment in runoff
  - Trapping/removing phosphorus, nitrogen, and other nutrients that can lead to eutrophication of aquatic ecosystems
  - Trapping and removing other contaminants, such as pesticides
  - Maintaining good water quality

Figure 59 Riparian buffer located in Putnam County on land in the Lake Erie Buffer region

  The 2008 average cost of tree/shrub establishment according to the LDAF, planting included would be approximately $135 and acre for hardwood and bare root seedlings; and approximately $130 an acre for pine/hardwood seedling mixture, planning cost included.

  Also, according to the LDAF, riparian forest buffers(391) moderately decrease mass movement of soil erosion; moderately decrease shoreline and streambank erosion; have a slight to moderated decrease in erosion due to wind; a moderated to substantial decrease in soil compaction; a slight to moderate decrease in contaminants from residual pesticides; a slight decrease in salts and other chemicals; a slight to moderate decrease in damage from sediment deposition; a moderate to substantial decrease in organic matter depletion; a moderate decrease in animal waste and other organics (N,K,P); a moderate decrease in contaminants from commercial fertilizer(N,P,K);there's a moderate increase in excessive runoff, flooding, or ponding; a slight to moderate decrease in excessive seepage and excessive subsurface water; there is a substantial decrease in sediment deposition and accumulation; a slight decrease in excessive nutrients and organics in groundwater and surface water; there is a moderate to substantial decrease in excessive suspended sediment and turbidity in surface water; a slight to moderate decrease in harmful levels of pathogens in groundwater and a moderate decrease in harmful levels of pathogens in surface water; there's a slight to moderate decrease in harmful levels of pesticides in groundwater; a moderate to substantial decrease in harmful levels of pesticides in surface water; and a moderate to substantial decrease in noxious and invasive plants.

  To enhance riparian buffer effectiveness, control grazing as well as weeds and brush in grass buffer areas. Remove sediment and reseed the buffer periodically.

Sugar Cane and Agronomic Crop BMP's:

- Use proper irrigation water management (NRCS Code 449) in hopes of timing and regulating water applications in a way that will satisfy the needs of a crop and efficiently distribute the water without applying excessive amounts of water or causing erosion, runoff or percolation losses. According to the LDAF, irrigation systems, sprinklers(442) have a moderate decrease in irrigation induced soil erosion; a moderate decrease in soil erosion due to wind; a slight increase in compaction; a moderate decrease in contaminants such as salts and other chemicals; a slight to moderate decrease in excessive runoff, flooding, or ponding; a slight decrease in excessive inefficient water use on irrigated land; a moderate decrease in sediment deposition and sediment accumulation; a slight decrease in excessive nutrients and organics in groundwater; a slight to moderate decrease in excessive nutrients and organics in surface water and salinity in surface and ground water; a slight decrease in harmful levels of pathogens in groundwater; a slight to moderated decrease in harmful levels of pesticides in groundwater and surface water; and a slight decrease in noxious and invasive plants. The 2008 average cost of a microirrigation system(441), including the installation and set up of a new system(filtration system and backwash controller) is approximately $45,000 each, or to have a conversion of existing surface irrigation system(442) to a low-pressure center pivot system(including materials and installation), it would cost about $44.25/ per AC.

- Conservation tillage and crop residue management are very effective at reducing soil erosion. These BMPs manage the intensity (frequency and aggressiveness) of soil disturbing activities related to residue management, seedbed preparation, nutrient application, planting and pest control while planting and growing crops. The benefits of implementing these practices would be that they may a)reduce erosion and transport of adsorbed particulate phosphorus (P) b)reduce runoff and transport of soluble Phosphorous c)conserve soil moisture for crop use and increased yield and 4)reduce particulate emission to the atmosphere. The soil surface year around, before and after planting, provides soil surface protection at critical times to protect the soil against wind and water erosion. Reducing tillage operations improves soil surface properties, including improved soil aggregation accounting for increased infiltration and percolation; less compaction due to less usage of field implements; and more biological activity due to an increase in organic matter. Adding soil surface cover increases water infiltration, reducing soil drying and maintains more moisture for crop utilization. Crop, climate and soil conditions impact the efficiency and effectiveness of this set of management practices, and can reduce soil erosion from 30 to 90 percent. Conservation tillage and crop residue management will reduce the number of unnecessary tillage passes. Each tillage pass would bury additional crop residue. Every ton of soil saved by controlling erosion will reduce P transport by a minimum of 0. 1 pound. Less tillage and greater amounts of crop residue on the soil surface provide the greatest protection from both soil erosion and nutrient runoff. Tillage operations require operator time, fuel and depreciation of equipment, all of which have a cost to the producer. The initial cost of equipment changeover and increased management required by the producer/operator will be offset by eventual savings in time, fuel and equipment depreciation(*USDA-NRCS).* According to the USDA Agricultural Research Services, Blanket residue (residue applied evenly over the soil surface) reduced runoff by 85 %, erosion by 95 %, and nitrate loss by 90 % compared to bare soil. Swept residue (residue applied as a center strip to mimic sweeping residue from row tops to the furrows) reduced runoff by only 6 %, but did decrease erosion by 60 % and nitrate loss by 32 % compared to bare soil. Leaving a residue blanket would provide the greatest environmental benefit. However, at slopes consistent with precision land-grading, sweeping residue to the furrows would decrease erosion to an acceptable rate, without increasing soil water content and reducing yield.

Figure 60 Soybeans planted into residue of previous crop

- Install field borders, filter strips, or other close-growing vegetation planted around fields and along drainage ways, streams and other bodies of water. They are designed to remove sediment, organic material, nutrients and chemicals carried in runoff. The base capital costs (without land costs) for vegetated buffer strips are approximately \$0.30 to \$0.70/ft² (WERF, 2003). According to the LDAF, installing field borders will have the following impacts: a slight increase in soil erosion due to mass movement; a slight decrease in soil erosion near the stream bank; a moderate to substantial decrease in soil erosion due to wind; a moderate decrease in soil condition due to compaction; a slight to moderate decrease in contaminants by residual pesticides; a slight decrease in other salts and chemicals; a moderate to substantial decrease in organic matter depletion; a slight to moderate decrease in damage from sediment deposition; a slight to moderate decrease in contaminants such as animal waste and other organics; a slight to moderate decrease in contaminants from commercial fertilizer, such as N, P, and K; a slight to moderated decrease in excessive runoff, flooding, or ponding; a slight to moderate increase in excessive seepage; a slight to moderate decrease in sediment deposition and in sediment accumulation; a slight to moderate decrease in habitat fragmentation; a slight to moderate decrease in excessive nutrients and organics in water; a slight to moderate decrease in excessive nutrients and organics in surface water; a slight to moderate decrease in excessive suspended sediment and turbidity in surface water; a slight decrease in harmful levels of pathogens in ground and surface water; a slight to moderate decrease in levels of harmful pesticides in surface water and a slight to moderate decrease in the imbalance among and within populations. As for filter strips, there is a substantial decrease in compaction; a slight to moderate decrease in contaminants by residual pesticides; a slight decrease in other salts and chemicals; a substantial decrease in organic matter depletion; a slight to moderate decrease in contaminants from commercial fertilizer, such as N, P, and K; a slight to moderate decrease in contaminants such as animal waste and other organics; a substantial decrease in sediment deposition and in sediment accumulation; a moderate decrease in excessive nutrients and organics in water; a slight decrease in excessive nutrients and organics in surface water; a slight decrease in excessive suspended sediment and turbidity in surface water; a slight decrease in harmful levels of pathogens in ground and surface water; and a moderate decrease in levels of harmful pesticides in surface water.

Figure 61 A well-established filter strip that is seeded with native warm season grasses located in Seneca County; on land in the Lake Erie Buffer region

From the TMDL, it was also found that sediments, nutrients, and fecal coliform are linked with pasture and rangeland. Livestock production and wild animals are a part of the local environment of Bayou Grosse Tete. Although livestock production encourages the maintenance of permanent vegetation on the land, when paired with the many wild animals roaming about, the fecal coliform bacteria and nutrients in their manure can contaminate water resources if the manure is mismanaged on a feedlot or a manure application area. Therefore, best management practices should be put into place to minimize this effect. Some of recommended practices are listed below:

- Nonstructural Controls
  - Divert clean surface water away from feedlot pens
  - Put filter strips/buffer strips in place
    - If sufficient distance is allowed between the fence and the stream, it is possible to develop a buffer strip to intercept runoff from the upslope pasture. It has been shown that riparian vegetation will filter sediment, nutrients, and other contaminants from runoff before it reaches the stream and stabilizes stream banks and reduces erosion (Section XII;Chalmers, L). Additionally, including a buffer strip between the stream and the fence makes it less likely that a streamside fence will be damaged in a flood. A Maryland Cooperative Extension publication recommends a buffer of at least 35 feet to allow for the flooding and changes in stream meanders that characterize the 'floodway' (Lynch, L). See load reduction and cost information under agriculture regarding this BMP.

Figure 62 Streambank fencing with a riparian streambank buffer

- Structural Controls
  - Treatment and disposal structures
  - Precipitation runoff retention structures
  - Conveyance ditches
  - Manure storage areas
    - A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure. This practice may reduce the nutrient, pathogen, and organic loading to surface waters. This is accomplished by intercepting and storing the polluted runoff from manure stacking areas, barnyards and feedlots. The 2008 average cost of a waste storage facility (313) including the storage structure, standard design, and a litter building (earthwork, concrete, building), is approximately $350. In terms of load reduction, there is a slight decrease in inefficient water use on irrigated land; a slight to moderate decrease in nutrients and organics in ground water and a moderate to substantial decrease in excessive nutrients and organics in surface water; a slight to moderate decrease in harmful levels of pathogens in ground water and surface water;

- Install fencing that will keep most animals a specified length away from water bodies. The type of fence constructed greatly impacts the cost per foot, total cost, and annual ownership cost. A conventional barbed wire fence can cost up to $1.50-per-foot-plus labor and material. A two-wire, permanent, smooth-wire electrical fence costs somewhere between 10 to 20 cents per foot depending on terrain (Burleson, Wayne). Conventional agricultural fencing of any type may be strengthened by the addition of a single electric line mounted on insulators attached to the top or front of the fence (Anonymous. 2008). The cost of materials for one mile of high tensile fence is site specific. Factors to consider are corner posts, terrain and the type of animals to keep in or fence out. High tensile wire costs about 1.5 cents per foot and is the cheapest part of an electric fence. Posts (use wood, fiberglass or metal) and insulators increase fencing cost the most (University of Minnesota). Keeping animals away from a waterbody will decrease the amount of fecal contamination in the bayou.

Figure 63 Electrical fence of high tensile wire. Not all strands are electrified, only those attached to fence posts with black insulators

- Livestock exclusion: Livestock exclusion may improve water quality by preventing livestock from being in the water or walking down the banks, and by preventing manure deposition in the stream. The amount of sediment and manure may be reduced in the surface water. This practice prevents compaction of the soil by livestock and prevents losses of vegetation and undergrowth. This may maintain or increase evapotranspiration. Increased permeability may reduce erosion and lower sediment and substance transportation to the surface waters. Shading along streams and channels resulting from the application of this practice may reduce surface water temperature. Average nitrogen excreted from cow-calf pair = 183 pounds N/year. Data compiled by Poore (2001). Manure N getting into creek due to direct loading one cow calf pair: (25.5 minutes/day) x (1 day/1440 min) x (183 lb N/yr) = 3.24 lb N/ cow-yr. The magnitude of this value can be greatly affected by the actual amount of time cattle spend in the water based on site specific factors, topography, etc. Direct deposition: manure N getting into creek adjusted for stocking rate of 1.5 ac/cow: (3.24 lb N/yr-cow)/(1.5ac/cow) =2.16lbN/ac-yr. Total nitrogen loading from pastures: background loading plus direct deposition: 4.6 lb/ac-yr + 2.16 lb N/ac- yr = 6.76 lb N/ac-yr. This calculation involves the export coefficient reported by Rochelle (1996); Point Value: 2.16 lb/ac-yr / 6.76 lb/ac-yr = 32 % reduction (North Carolina Department). Studies have also reported that streamside exclusion fencing reduced sediment concentrations in storm runoff and total sediment transport by 60% and 40%, respectively, compared to pre-fenced conditions (Owens, L. B). Excluding livestock from the stream stabilizes streambanks and improves riparian vegetation and the quality of fish and wildlife habitat in and near the stream. Additionally, aquatic life habitat and diversity increases after livestock are excluded from the stream (Zeckoski,R).

Agricultural BMPs focus on five main areas: nutrient management, pesticide management, soil and water management, pasture management and general farm BMPs. Each BMP is a culmination of years of research and demonstrations conducted by agricultural research scientists and soil engineers. Through these cooperative efforts, Louisiana Department of Environmental Quality expects that BMP implementation within the Bayou Grosse Tete area as they pertain to agriculture will increase; Consequently, the increased level of Best Management Practice implementation should result in a reduction of nonpoint source pollutant loads and a measurable water quality improvement. BMPs and accompanying standards and specifications are published by the NRCS in its Field Office Technical Guide. Additional Best Management Practices for sugarcane can be found at http://www.lsuagcenter.com/NR/rdonlyres/E82EC6A3-0FC4-4BDC-8793-9222CE4E4697/3155/pub2833Sugarcane4.pdf; Additional BMP's for Agronomic crops can be found at http://www.lsuagcenter.com/NR/rdonlyres/3EF63A05-7F99-4D72-84ED-1ABBC9628879/3109/pub2807CropsBMP2.pdf

7.3 Urban Areas/Residential Development

According to the TMDL for Bayou Grosse Tete, ineffective home sewage systems are contributing to the inadequate water quality of the area. However, educating the home owners on the correct pesticide/fertilizer use on their lawn, increasing regulations on new construction, in addition to improving home sewage systems may contribute to the improvement of the waterbody. Home sewage systems in this part of the state typically are either a septic tank with a field line or a mechanical treatment system, which is similar to a septic tank, but has a pump for aeration and does not have field lines. Field lines are only effective when the soils that they are installed in allow for percolation through the surface soil and degradation by microbial populations that reside within the soil. Many of the soils in this part of the state either have shallow water tables or do not percolate very well. For that reason, the mechanical treatment system is fairly common and does result in a discharge that may enter the water bodies. Inadequately treated human sewage is a source of fecal coliform bacteria, pathogens, and excess nutrients in Bayou Grosse Tete. By implementing the following Best Management Practices, water quality in Bayou Grosse Tete may be improved.

Figure 64 Home sewage pipe depositing into Bayou Grosse Tete

- Install rain barrels (cisterns) which are barrel shaped devices used for recycling rain water from a home's roof. Rain barrels attach to a gutter's downspout enabling the homeowner to catch their roof's rain water and store it for later. The homeowner can water their plants and gardens with the recycled rain water as needed. Rain water is better for plants than municipal water because it's free of chlorine and other chemicals. Rain barrels are great for the environment because they reduce water run-off. When it rains, in many cases, roof water travels down gutters and runs off of the lawns too fast, before it's able to be absorbed. And in many cases the downspouts drain directly into the street. What a waste! In these situations the water carries fertilizers and oil from the lawns and streets into our precious waterways. And that contributes to drought-like conditions. This problem gets worse with urban sprawl. By capturing rain water and releasing it slowly, when the weather is dry, water is used and returned to the environment at the rate that nature intended. According to LDAF, roof runoff structures provide a slight decrease in stream bank erosion and damage from sediment deposition; a slight decrease in excessive seepage and excessive subsurface water, but a slight increase in excessive runoff, ponding, or flooding;there is a moderate decrease in inefficient water use on non-irrigated land; a slight decrease in sediment deposition and accumulation; a slight to moderate decrease in excessive nutrients and organics in ground and surface water; a slight decrease in excessive suspended sediment and turbidity in

Figure 65 Modernized rain barrel

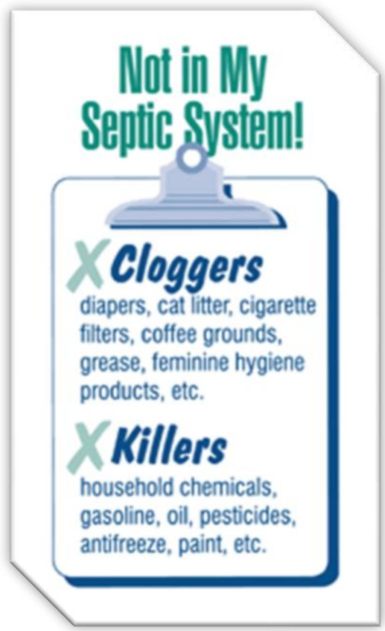
surface water; a moderate decrease in harmful levels of pathogens in surface water.

- Direct new development away from streams and rivers. Generally, this is more cost-effective in controlling pollution than trying to retrofit engineering solutions once an area has developed. Building homes away from the bayou will decrease the chances that sewage will be depositing directly into the bayou, thereby, greatly reducing loading.

- Inspect 100% of newly installed septic systems. If the systems are inspected correctly, and pass, that means they are functioning correctly, and not polluting the area; therefore, there will be no loading into the bayou.

- Amend zoning ordinance to require inspection of septic systems at point of sale. If you are purchasing a home with a septic system it would be smart to inspect and test that system before completing the purchase. Knowing the age, location, type of equipment, and condition of the septic system can reduce (not eliminate) the chances of an expensive surprise (like a septic system that does not work), and it can reduce the chances of a dangerous site condition (like an old cesspool or tank about to collapse). If the inspection is carried out correctly, and the system is functioning the way it should, there should be no loading into the bayou. The inspection would consist of:
    - The current use of the system and the effects of the use; the condition and performance of the septic tank; and the condition and performance of the soil treatment system. The cost of a septic system inspection will vary around the country according to local labor rates.

- Inspect your septic system annually and pump out your septic system regularly. (Pumping out every three to five years is recommended for a three-bedroom house with a 1,000-gallon tank; smaller tanks should be pumped more often.) This is generally as simple as calling your septic company, and asking them to send a pumper truck around. (Of course, if you don't know where the manhole cover for your septic tank is, this may not be so simple!) They will vacuum out the sludge (called septage) found in your septic tank, and haul it off for disposal at a sewage treatment plant. After you've had your tank pumped out, be sure to record the date of the pumping, so that you know when to have your septic company come back. Also, be sure to save a diagram that tells you where the manhole cover is located, so that you can find it next time.



- Do not use septic system additives. There is no scientific evidence that biological and chemical additives aid or accelerate decomposition in septic tanks; some additives may in fact be detrimental to the septic system or contaminate ground water. There are no added costs associated with this particular management measure. The homeowner will actually save money because they would not be spending it on expensive, unnecessary chemical additions.

- Educational Outreach
    - Each should promote clear identification and understanding of the problem and the solutions; identify responsible parties and efforts to date; promote community ownership of the problem and its solutions; change behaviors; and integrate public feedback into program implementation. Potential topics include:
        - Lawn care and the proper use of pesticides, herbicides, etc.
        - Steps homeowners can take to reduce the pollution from their individual home sewage system. The cost of this management measure would not be expensive.

Outreach would involve pamphlets, videos, brief talks, and can be presented at carnivals, town hall meetings, or schools.

- Develop a Pilot Program that will inventory and upgrade all septic systems that are defined as imminent threats to public health. Financial assistance can be through grants or through low-interest loans.

7.4 Hydromodification

Given that much of the Terrebonne Basin lies within wetlands, it is not surprising that channelization for drainage of agricultural lands and communities have been an everyday activity. The ridges and natural levees along the bayous are the main areas for building homes and communities. As the population in Grosse Tete grew and sugarcane farms expanded from the ridges to the lower lands, people created drainage canals to convey water from these areas of low elevation into the bayous and lakes. During storm water events, these drainage canals transport both the storm water and the pollutants from the fields and the cities to the waterways. During the part of the year, when the winds are from the south and the tides move the estuarine waters back up into the bayous and canals, drainage becomes a real problem. The solution is often to clear and snag the bayou or drainage canal and make it wider and deeper to offset the flooding problems that exist on the farms and in homes. However, this is a complicated issue and often expensive to correct; therefore, there is no one solution to correct the problem. These circumstances were created from years and years of demolition and obliteration; consequently, it is not logical to assume that it can be corrected in an instance. Hence, the following Best Management Practices are recommended to help improve the water quality of the Bayou Grosse Tete area that has been affected for so long by hydromodification.

- Riparian vegetation is very important and should be incorporated into hydromodification projects along the bayou for the following reasons:
  - Flood control: during high stream flows, riparian vegetation slows and dissipates floodwaters. This prevents erosion that damages fish spawning areas and aquatic insect habitats.
  - Bank stabilization and water quality protection: the roots of riparian trees and shrubs help hold stream banks in place, preventing erosion. It also traps sediment and pollutants, helping keep the water clean.
  - Wildlife habitat: riparian vegetation provides food, nesting, and hiding places for some animals.

- Develop tactics to enforce stream bank protection, such as:
  - Protection of existing vegetation along stream banks
    - Preserving onsite vegetation retains soil and limits runoff of water, sediment, and pollutants. The destruction of existing onsite vegetation can be minimized by initially surveying the site to plan access routes. Reducing the disturbance of vegetation also reduces the need for revegetation after construction is completed, including the required fertilization, replanting, and grading that are associated with revegetation. Additionally, as much natural vegetation as possible should be left next to the waterbody where construction is occurring. This vegetation provides a buffer to reduce the NPS pollution effects of runoff originating from areas associated with the construction activities.

Figure 66 Erosion Control Blanket

- Installation of stone riprap revetment, erosion control fabrics and mats, burlap sacks, cellular concrete blocks, and bulkheads.
    - Riprap is a layer of appropriately sized stones designed to protect and stabilize areas subject to erosion, slopes subject to seepage, or areas with poor soil structure. The approximate cost to implement, including purchase, hauling, and placement, is approximately $40 a ton(NRCS)
    - Erosion Control Blankets are turf reinforcement mats (TRMs) combine vegetative growth and synthetic materials to form a high-strength mat that helps prevent soil erosion in drainage areas and on steep slopes; labor to install/per sq yd $4.00; for materials, Erosion Control Matting Permanent approximate cost $2.00 sq yd; for Temporary, approximate cost $0.70 sq yd (NRCS)

- In regards to the weir:
    - The waterway can hold more water, so send more water down it. Due to the lack of flow, more water is needed in this area to flush out the Bayou. Water can be pumped out of the Mississippi River and sent through this region to dilute the pollutants. The USACE Waterways Experiment Station (Wilhelms,1988) has compared the effectiveness with which various hydraulic structures accomplished the reaeration of reservoir releases. The study concluded that, whenever operationally feasible, more discharge should be passed over weirs to improve DO concentrations in releases.

Figure 67 Agricultural land directly across the street from Bayou Grosse Tete being sold for residential development; notice the tractor in the background

According to the Total Maximum Daily Load for Bayou Grosse Tete, natural sources are not contributing to nonpoint pollution in the subsegment. However, the TMDL does state that Bayou Grosse Tete requires a watershed wide 95% decrease in manmade nonpoint source loads for the summer and winter months. In addition, it shows that the existing point sources have no impact on the main stem of Bayou Grosse Tete and require no changes to their permitted discharges. Accordingly, BMPs need to be implemented in and around Bayou Grosse Tete to help in the reduction of pollution from manmade nonpoint sources; thereby, having a dissolved oxygen standard of at least 5 mg/L to allow it to support its designated uses.

8.0 MAKING THE IMPLEMENTATION PLAN WORK

Financial and technical assistance from federal, state, and local individuals are required if the nonpoint source pollution load in Bayou Grosse Tete is to be reduced. The local community surrounding Bayou Grosse Tete should realize that their involvement and commitment, or lack thereof, in the programs and/or recommendations will make the difference in whether the water quality of their Bayou improves or continues to disintegrate. Given that there are few regulations pertaining to nonpoint source pollution, the citizens of subsegment 120104 are integral pieces of the puzzle when it comes to implementing the Best Management Practices in their area.

8.1 Actions Being Implemented by the LDEQ

LDEQ is presently the designated lead agency to implement the Louisiana State Nonpoint Source Program. LDEQ Nonpoint Source unit works in cooperation with private, profit and nonprofit organizations that are authentic legal entities, or governmental jurisdictions including: cities, counties, tribal entities, federal agencies, or agencies of the State on approximately 40 nonpoint source projects that are active throughout the state.

8.2 Actions Being Implemented by other Agencies

- **Barataria-Terrebonne National Estuary Program**

  The Barataria-Terrebonne National Estuary Program has coordinated federal, state, and local agencies, the citizens and the environmental community to assist in establishing priorities for this special part of the state. All of these priorities were compiled into a set of Action Items, which comprise the Comprehensive Conservation and Management Plan. The staff within the BTNEP has formed Implementation Teams that will work together on these Action Items to ensure that they are implemented throughout the two management basins that form the BTNEP. The staff has worked closely with NPS Program staff on water quality issues related to nonpoint sources of pollution. This working relationship will continue as LDEQ collects water quality data, develops TMDLs and implements watershed management strategies in the Barataria and Terrebonne basins.

- **Natural Resource Conservation Service**

  The NRCS has been actively involved in both the development and implementation of Action Items related to agricultural issues in the Barataria and Terrebonne basins. They have prioritized watersheds within these basins for basin studies and have worked with the state's NPS Program on implementation of sugarcane best management practices. This working relationship will continue as the cooperating agencies that serve on Implementation Teams work on the Action Items that were identified within the Comprehensive Conservation and Management Plan as agricultural issues.

- **2003 Farm Bill**

  Provides funding to various conservation programs for each state by way of the NRCS and local Soil and Water Conservation Districts (SWCD). The following includes a brief summary of the programs available through the local SWCD under the oversight of USDA and NRCS. The descriptions of the programs are general and are subject to change.
  - **Environmental Quality Incentive Program (EQIP)** provides 75% - 90% cost share for environmentally beneficial structural and management alterations, primarily 60% to livestock operations. Applications prioritized for benefits. It is considered the "Working Lands" program.
  - **Wildlife Habitat Incentive Program (WHIP)** also provides 75% - 90% cost share but for the costs of wildlife habitat restoration and enhancement on private lands. This program available to eligible private property owners and lessees for installing riparian buffers, native pine & hardwoods, wildlife corridors and other wildlife enhancing measures for 5 – 10 year contracts
  - **Wetland Reserve Program (WRP)** is a voluntary program for wetland restoration, enhancement and protection on private lands. WRP provides annual payments and restoration costs for 10 year, 30 year, or perpetual easements on prior converted wetlands. Louisiana leads the US in WRP participation. The 2002 Farm Bill total funding allocation was $1.5 billion and it expanded the program to purchase long-term easements and cost sharing to agriculture producers.
  - **Conservation Reserve Program (CRP):** The 1985 Farm Bill established CRP as a voluntary program to protect highly erodible and environmentally sensitive lands. CRP places a positive value on rural

Figure 68 Ditch on side of road that that leads to Bayou Grosse Tete

environment by improving soil, water, and wildlife, and extends a pilot sub-program called the Conservation Reserve Enhancement program.

- **Conservation Security Program (CSP)** is a new national incentive payment program for maintaining and increasing farm and ranch stewardship practices. The CSP is designed to correct a policy disincentive in which independently conducted resource stewardship has disqualified many farmers from receiving conservation program assistance. CSP features an optional "tiered" level of farmer participation where higher tiers receive greater funding for greater conservation practices.
- **Farmland Protection Program (FPP)** provides funding to states, tribes, or local governments and to nonprofit organizations to help purchase development rights and protect farmlands with prime, unique, or productive soil; historical or archaeological significance; or farmlands threatened by urban sprawl. Louisiana does not currently have any FPP contracts.
- **Grassland Reserve Program (GRP)** is also a new program created to enroll up to 2 million acres of virgin and improved pastureland. GRP easements would be divided 40/60 between agreements of 10, 15, or 20-years, agreements and easements for 30-years and permanent easements to restore grassland, rangeland and pasture through annual rental payments.
- **Small Watershed Rehabilitation Program (SWRP)** provides essential funding for the rehabilitation of aging small watershed impoundments and dams that have been constructed over the past 50 years.

Figure 69 Riparian wildlife in Bayou Grosse Tete

Louisiana Department of Agriculture and Forestry

LDAF has also worked with the BTNEP on development of action items that were contained in the Comprehensive Management Plan. Their soil and water conservation districts are the primary link with the farmers and landowners that can implement best management practices on their lands. As the Action Items contained with the CCMP are addressed, these districts will continue to play a major role in their implementation.

LSU Agricultural Center

LSU has worked closely with the state's NPS Management Program to evaluate best management practices for sugarcane. These practices have included conservation tillage, pesticide and nutrient management practices and the affect that new sugarcane harvesting methods have on pollutant transport from the fields. The sugarcane industry is constantly changing to meet the demands of a competitive market, so environmental practices need to keep pace with these changes and recommend the most innovative practices for the farmer. LSU has developed The Master Farmer Program, which is used to encourage on-the-ground BMP implementation with a focus on environmental stewardship. The LSU AgCenter is promoting this program to help farmers address environmental stewardship through voluntary, effective and economically achievable BMPs. The LSU AgCenter will tailor its Master Farmer Program to meet the needs of the producers in the watershed area. The program will be implemented through a multi-agency/organization partnership including the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the Louisiana Cooperative Extension Service (LCES), USDA-Agriculture Research Service (ARS), LDEQ and agricultural producers.

- **The Master Farmer Program** has three components: environmental stewardship, agricultural production and farm management. The environmental stewardship component has three phases. Phase one focuses on environmental education and implementation of crop-specific BMPs. Phase two of the environmental component includes in-the-field viewing of implemented BMPs on Model Farms. Phase three involves the development and implementation of farm-specific and comprehensive conservation plans by the participants. A member must participate in all three phases in order to gain program status and receive the distinction of being considered a master farmer.

Louisiana Cooperative Extension Service

LCES plays a very important role in the educational component of the NPS Management Program. They provide the farmers, local citizens, and science teachers and children with information on water quality, wetlands, habitat protection and a host of other environmental issues. Summer camps offer high school students the opportunity to learn about coastal environments, marshes, and estuaries. Marsh Maneuvers has been a very popular learning experience for students to actually spend a week in the marsh, learning about every aspect of its unique ecology. LCES has hosted and participated in workshops for science teachers on water quality, nonpoint source pollution, watershed management and wetland protection. They are the backbone of the state's educational system for adults and children on agriculture and environmental issues, and it is anticipated that they will continue to be a major partner in this important area.

Department of Health and Hospitals

The DHH has worked on nonpoint source problems associated with home sewage systems across the Barataria-Terrebonne basins. In many areas, they have inventoried these systems and determined where maintenance problems exist or new systems need to be installed. They have worked with BTNEP and the Gulf of Mexico Program on the Shellfish Strategy and provided data and information on shellfish closures and oyster growing waters that are under stress from pollution. As BTNEP works with the Implementation Teams on the Action Items, DHH will continue to play a major role in addressing pollution that is associated with home sewage systems.

Coastal Management Division of Department of Natural Resources

CMD/DNR has been a partner in development of the CCMP for the BTNEP. Since portions of the Barataria and Terrebonne basins lie within the coastal zone management area, they have worked to understand how their programs and coastal use permits can be utilized to assist with managing water quality and habitat issues in Louisiana's coastal areas. They have participated in the Nonpoint Source Coalition meetings and educated people about the Coastal Nonpoint Pollution Control Program. As BTNEP moves into the implementation phase of their program and LDEQ moves into these basins for TMDL development and watershed management, CMD/DNR will continue to be an important partner to assist in the implementation of nonpoint source management practices.

Figure 70 Turtle swimming in the murky water of Bayou Grosse Tete

South Central Planning and Development

South Central Planning and Development is a local entity that assists the cities and parishes with many of their planning and development programs. They have worked closely with LDEQ on implementation of nonpoint source educational programs across the Barataria basin. They have hosted meetings with city and parish officials on nonpoint source issues and assisted LDEQ in building local support for the program.

They have begun to work with the BTNEP staff on these educational programs and are expected to continue to be a major cooperator and supporter for both nonpoint source education and watershed implementation.

Gulf of Mexico Program

The Gulf of Mexico Program has worked with LDEQ and the BTNEP on the Shellfish Strategy. They provided all of the technical support for development of the strategy and worked with BTNEP to host workshops in the Barataria Basin to gain local support for the strategy. They have also provided funding to support a Coordinator, whose primary role is to track progress made in implementation of the strategy. The Nutrient Focus Team of the GOMP has also worked with industry, federal, state and local agencies, citizens and the environmental community on management strategies to reduce the concentration of nutrients from both the point and nonpoint sources within the Barataria-Terrebonne basins.

Local Parish and Municipal Governments

Local governments play such an important role in both the educational and watershed management portions of the NPS Management Program. They understand the local problems and infrastructure that is the mechanism for program implementation. They advise and guide LDEQ and BTNEP on how their action items can be achieved and how programmatic goals and objectives can be attained. Without their support, the program simply will not work. They understand the history of the local problems and the reasons why some solutions will work and others will fail. They have responsibilities to the people who live within the basin and need to be informed and involved in any decisions that may affect the people, economy or the resources in their area. Both BTNEP and LDEQ have worked to foster good working relationships with the local decision-makers and will continue to rely on their local expertise for future program implementation.

- **Local Environmental Community**

  The Environmental Community has supported the BTNEP and participated in the planning process for the CCMP. They have highlighted the environmental problems that exist with saltwater intrusion and wetland loss, nutrients and pesticides from agricultural crops, and pressured both industry and government to reduce pollution from both the point and the nonpoint sources that exist across the basin. They play an important role in raising the awareness of the public about the environmental problems that exist and working to ensure that everyone continues to work to reduce these problems. Both BTNEP and LDEQ will continue to work with them as implementation strategies and TMDLs are implemented throughout the basin.

- **Local Civic Organizations**

  The local civic and service organizations are comprised of key leaders within the community. These people care about their community and want to work on programs that improve the environment and their local economy. They are the farmers, the homeowners, and the city and parish leaders that need to be involved in programs that educate the people about their water quality issues. They will be included in the educational outreach programs planned for TMDLs and watershed management and are viewed as local decision-makers in how these programs are implemented.

- **Local Universities, Schools**

  The universities and the schools have such an opportunity to become involved in the water quality, habitat protection and wetland issues that exist across the Terrebonne basin. Many of them have and already conduct their own water quality testing programs and have become involved in environmental education. As both the BTNEP and LDEQ work on watershed implementation, there will be opportunity for their involvement in many aspects of the programs. Surveys of home sewage systems, habitat assessment along bayous and streams, participation in demonstration projects and educational programs are all examples of activities that local schools and university students and teachers can become involved in. In some parts of the state, students have restored urban streams and worked with the Corp of Engineers to protect wetlands. They have innovative ideas and enjoy working on local issues where short-term progress can be seen.

Information regarding conservation treatments specifically in Bayou Grosse Tete is currently unavailable. However, according to the Terrebonne and Levee Conservation District, there are several projects under way or have been completed concerning flood protection, levee restoration, and even marsh management. There was also a project which sought to develop a water management plan to reduce flooding of residences and maintain the optimum water levels for wetland regeneration; and also one which sought to stabilize water levels, reduce salinities, and improve wildlife habitat. Further details of the projects can be found at http://www.tlcd.org/currentprojects.htm.

8.3 IMPLEMENTATION & MAINTENANCE

Locating funding for implementation and maintenance of best Management Practices are key elements in a successful Implementation Plan. There are a number of Federal and State funding sources that exist for BMP implementation, riparian zones, and land conservation.

8.3.1 Cost Share

The LDEQ Nonpoint Source Unit provides USEPA §319(h) funding to assist in the implementation of BMPs seeking to address water quality problems in areas listed on the §303(d) list. USEPA §319(h) funds are to be used to implement programs and projects designed to reduce nonpoint source pollution. 319(h) funds are available to all private, for profit and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, federal agencies, or agencies of the state. Proposals are submitted by applicants through a Request for Proposal (RFP) process and require a non-federal match of 40% of the total project cost consisting of funds and/or in-kind services. Further information on funding from the Clean Water Act §319 (h) can be found on the LDEQ web site at: www.deq.state.la.us.

8.3.2 Other Federal and State Funding

The United States Department of Agriculture (USDA) offers landowners financial, technical, and educational assistance to implement conservation practices on privately owned land with the goal of reducing soil erosion, improve water quality, and to enhance crop land, forest land, wetlands, grazing lands and wildlife habitat. One of the programs sponsored by the USDA is the Conservation Reserve Program (CRP). It is designed to encourage farmers to convert highly erosive cropland to vegetative cover, such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive annual rental payment for the term of the multi-year contract. An additional program, The Conservation Reserve Enhancement Program (CREP), combines the resources of the CRP program with that of the State government. This program focuses on NPS pollution, water and habitat restoration. The Environmental Quality Incentives Program (EQUIP) is another source of funding available to the farmers for conservation practices. These are only a few ,of many, State and Federal funding sources available to agricultural landowners that will help with the cost of reducing NPS run off from their fields.

9.0 TIMELINE FOR IMPLEMENTATION

According to The NPS Management Plan, a watershed plan should be developed for Bayou Grosse Tete in the year 2007 to reduce NPS pollutants reaching the area. Additional ambient surface water quality monitoring should be performed in the years' 2008 through 2009, and the management plan should be updated where needed. Implementation of the Bayou Grosse Tete Watershed Plan will be carried out from year 2010 through 2012. Throughout the process, tracking the successes and/or failures of each Best Management Practice as well as the status of restoring the Bayou's designated uses is essential. If no improvement in water quality is witnessed by the 2012 sampling, LDEQ will revise the Implementation Plan to include additional corrective actions to bring the waterway into compliance. Additional BMPs and or other options will be employed, if necessary, until water quality standards are achieved and Bayou Grosse Tete has its designated uses restored.

9.1 Tracking and Evaluation

As stated in the Louisiana Nonpoint Management Plan, program tracking and evaluation will be done at several levels to determine if the watershed approach is an effective method to reduce nonpoint source pollution and improve water quality. The steps for tracking and evaluation are as follows:

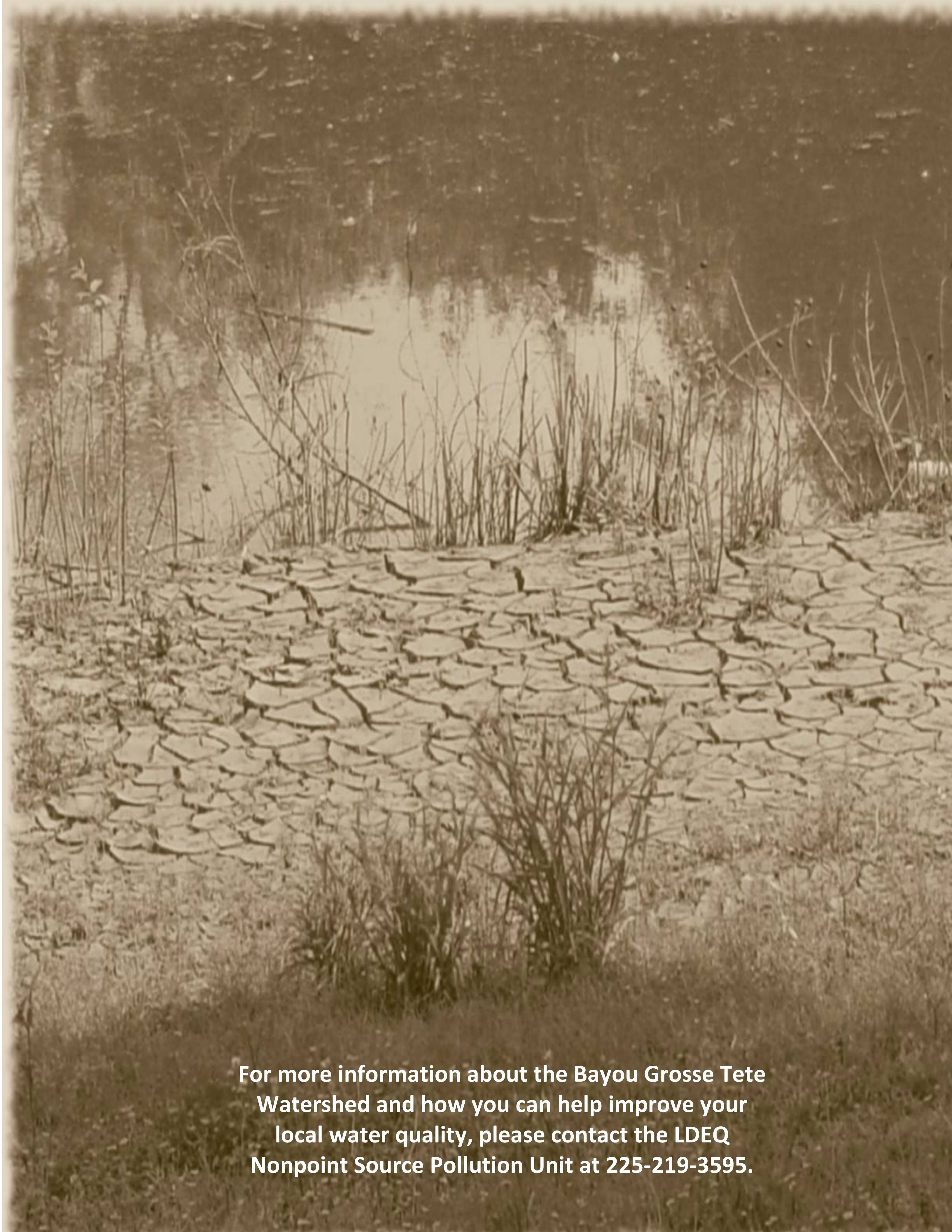
1. Tracking of actions outlined with the Watershed Restoration Action Strategy (short-term)
2. Tracking of BMPs implemented as a result of Section 319, EQIP, or other sources of cost-share ant technical assistance within the watershed (short term)
3. Tracking the progress in reducing nonpoint source pollutants such as solids, nutrients and organic carbon from the various land uses (rice, soybeans, pastureland grazing) within the watershed (short-term)
4. Tracking water quality improvement in the bayou for instance decreases in total organic carbon and increases in total dissolved oxygen (short and long term)
5. Documenting results of the tracking to the Nonpoint Source Interagency Committee, residents within the watershed, and EPA (short and long term)
6. Submitting semi-annual and annual reports to EPA which summarize results of the watershed restoration actions (short and long term)
7. Revising LDEQ's web-site to include information on the progress made in watershed restoration actions, nonpoint source pollutant load reductions, and water quality improvement in the bayou (short and long term).

10.0 SUMMARY OF BAYOU GROSSE TETE WATERSHED IMPLEMENTATION PLAN

Bayou Grosse Tete, subsegment 120104, does not meet the water quality standards for dissolved oxygen and nutrients. With the aim of restoring the designated uses of primary contact recreation and fish and wildlife propagation, there needs to be a 95% reduction in the summer and winter of manmade nonpoint source loads. To meet this goal, a collaborative effort from the citizens of the area, special interest groups, and the government, is essential. These problems should be addressed through basin-wide educational programs encompassing restoration and management strategies for sugarcane, pastureland, home sewage systems, urban runoff and hydromodification. Best Management Practices and regulations are available for reducing non point source pollutant loads from these causes; and if followed properly, should reduce most of the suspected causes of impairments in the watershed. Financial support can be provided through USEPA §319(h) funds or by financial, technical, or educational assistance through the USDA.

The short-term goal for managing these water quality problems is to work with the local community, decision-makers, state and federal agencies to implement management measures and Best Management Practices that can reduce the concentration of sediment, nutrients, bacteria and metals leaving the land during rain fall events. The long-term water quality goal is to be able to measure a reduction in the in-stream concentration of these pollutants and to restore the designated uses for the water body. From the implementation of this watershed plan, we should expect to gain better working relationships among organizations; a better use of science to understand how human activities affect our water resources; a better protection for our water bodies; and most importantly, cleaner water. Ultimately this responsibility lies on the shoulders of everyone who lives works or plays in the Bayou Grosse Tete Watershed.

Although some of the BMPs and their recommended courses of action were described within this plan, a consolidated list of BMPs recommended for each of these land uses can be viewed in the State of Louisiana Water Quality Management Plan, Volume 6 (LDEQ, 2000). Detailed BMP manuals for agronomic crops, rice, poultry, sugar cane, dairy, sweet potato, swine, beef, and aquaculture have been produced by LSU AgCenter and are available on their website http://www.lsuagcenter.com/Subjects/bmp/index.asp. For all entities involved in silvicultural operations, the Recommended Forestry Best Management Practices for Louisiana manual has been and will continue to be an invaluable source of information and recommendations (LDEQ, 2000).



For more information about the Bayou Grosse Tete Watershed and how you can help improve your local water quality, please contact the LDEQ Nonpoint Source Pollution Unit at 225-219-3595.

Appendix

Elements of Successful Watershed Plans

A. Identification of Causes and Sources of Impairment

An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan). Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed. Information can be based on a watershed inventory, extrapolated from a subwatershed inventory, aerial photos, GIS data, and other sources.

B. Expected Load Reductions

An estimate of the load reductions expected for the management measures proposed as part of the watershed plan. Percent reductions can be used in conjunction with a current or known load.

C. Proposed Management Measures

A description of the management measures that will need to be implemented to achieve the estimated load reductions and an identification (using a map or description) of the critical areas in which those measures will be needed to implement the plan. These are defined as including BMPs (best management practices) and measures needed to institutionalize changes. A critical area should be determined for each combination of source and BMP.

D. Technical and Financial Assistance Needs

An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan. Authorities include the specific state or local legislation which allows, prohibits, or requires an activity.

E. Information, Education, and Public Participation Component

Any information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

F. Schedule

A schedule for implementing the NPS management measures identified in the plan that is reasonably expeditious. Specific dates are generally not required.

G. Milestones

Any description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented. Milestones should be tied to the progress of the plan to determine if it is moving in the right direction.

H. Load Reduction Evaluation Criteria

A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the watershed-based plan needs to be revised. The criteria for loading reductions do not have to be based on analytical water quality monitoring results. Rather, indicators of overall water quality from other programs can be used. The criteria for the plan needing revision should be based on the milestones and water quality changes.

I. Monitoring Component

A monitoring component to evaluate effectiveness of the implementation efforts over time, measured against the criteria established under the evaluation criteria. The monitoring component should include required project-specific needs, the evaluation criteria, and local monitoring efforts. It should also be tied to the State water quality monitoring efforts.

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